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PRINCE HENRY OF PRUSSIA AND HIS FLEET.

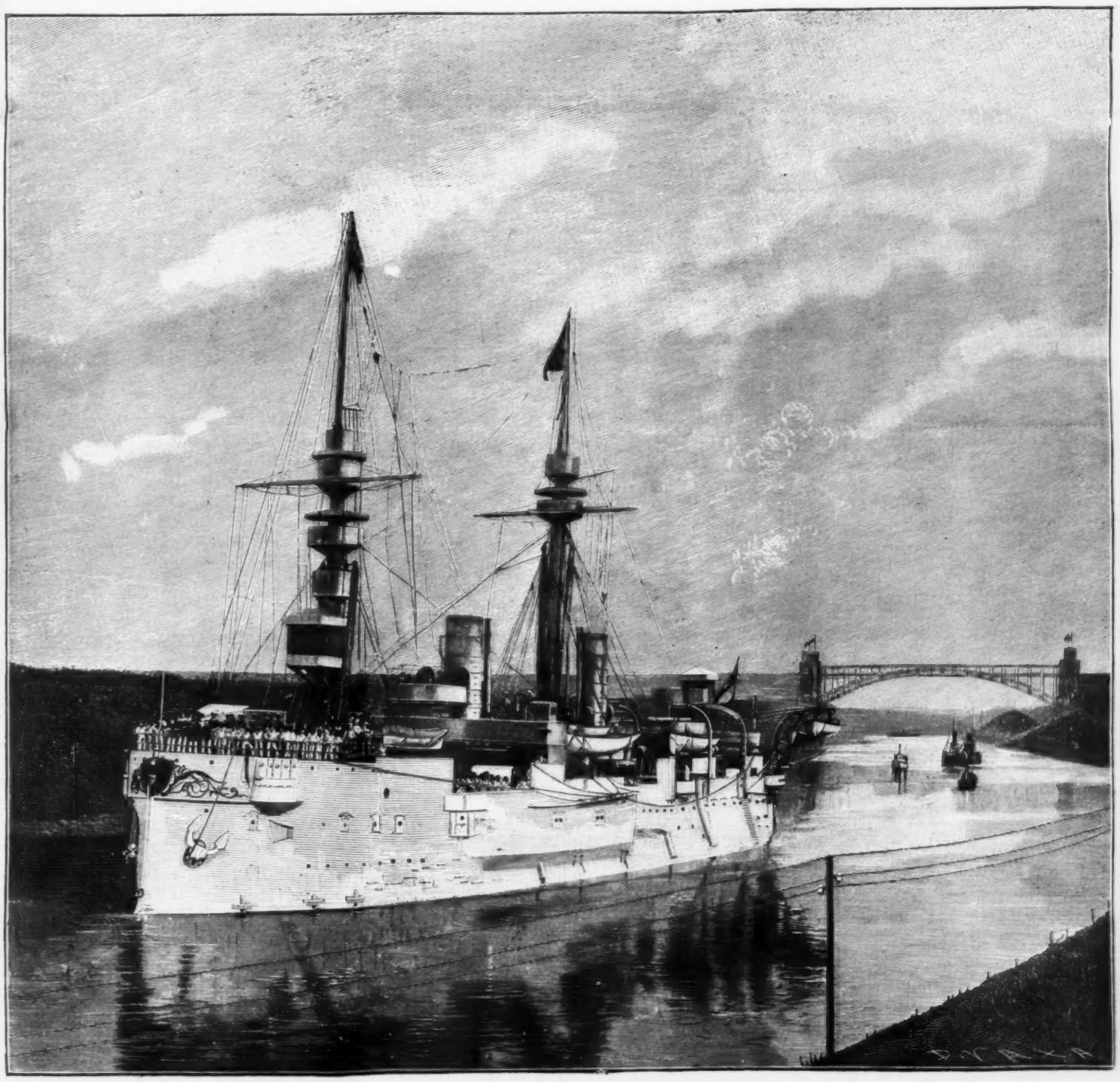
WE publish to-day engravings of Prince Henry of Prussia and of the vessels constituting the Second Cruiser Division, placed under his command for work in Chinese waters, where the movements of Germany have been attracting the attention of the world for two months past. The story of Prince Henry's departure from Kiel, with the melodramatic farewell of the Emperor, is so well known that we need not dwell upon it now, so will pass immediately to a description of the three cruisers. They are the armored cruiser "Deutschland," of the first class; the cruiser "Kaiserin Augusta," of the second class; and the cruiser "Gefion," of the third class. Prince Henry raised his flag on the "Deutschland" at Kiel on December 10, thus taking command of the division.

When the order for the formation of the division was issued, the "Kaiserin Augusta" and "Gefion" were already in commission, but the "Deutschland" had to be placed on the imperial docks at Wilhelmshaven for some small repairs and a coat of white paint for tropical waters, and to be loaded with ammunition, coal and provisions, before it was ready for service. It was not an easy matter to arrange for the reception of the division staff and to give the desired comfort and elegance to the admiral's (prince's) mess, but many hands were kept busy day and night until everything was finally in readiness, and at nine o'clock on the morning of December 2 the flag was raised at the stern, with many hurrahs from the crew, thus showing that the ship had been put in commission. The trial trip was made and then the vessel was taken to Kiel, where the prince and his staff boarded her. She sailed from that port on December 16, and it is expected that she will arrive at Hongkong about February 11. The sister ships "Deutschland" and "Kaiser" were built in England in 1874, and they were rebuilt in 1895, after which they were classed as armored cruisers. The "Deutschland" is built of iron, is 278 feet 10 inches long, 62 feet 4 inches wide, and 25 feet 3 inches deep, and it has a speed of 14 knots an hour. Its armor belt is 10 inches thick and the armor for the sponsons is 8 inches thick.

It has a displacement of only 7,676 tons, and a speed of 14 knots an hour. The commander of the flagship is Capt. Plachte and the first officer Capt. v. Bassewitz.

The second cruiser of the division, the "Kaiserin Augusta," was the first triple-screw cruiser in Germany. It is well known on account of its participation in the Columbus Naval Review in 1893, its expedition to Morocco in 1895, and finally, its mission at the seat of the Greco-Turkish war. Its greatest speed is 22 knots an hour. The commander of the vessel is Capt. Köllner, and the first officer Capt.-Lieut. Gerdes.

The third vessel of the Prince's division, the "Gefion," was formerly stationed at Kiel. It is remarkable for its slender, elegant form, and it made a name for itself when acting as escort to the imperial yacht "Hohenzollern," in Norway, by pulling off a French steamer that had gone aground. It has a speed of 16 knots an hour. The commander of this vessel is Capt. Follenius,



PRINCE HENRY AND HIS TRIP TO CHINA—THE CRUISER "DEUTSCHLAND" IN KAISER WILHELMS CANAL.

and the first officer Capt.-Lieut. v. Oppeln-Bronikowski.

The crews and armament of the vessels of the second division are as follows: The "Deutschland," 644 men, 12 heavy guns and 28 rapid fire guns; the "Kaiserin Augusta," 418 men, 12 heavy guns and 16 rapid fire guns; the "Gefion," 302 men, 10 heavy guns and 14 rapid fire guns; making a total of 1,364 men, 34 heavier guns and 58 rapid fire or machine guns. The first division includes 1,642 men, 54 heavy guns and 56 rapid fire guns.

The squadron will be assisted in its work on land by a naval battalion, a company of artillery with land guns, and a detachment of pioneers. The naval battalion, consisting of 1,200 men, was formed of men taken from the two naval battalions and volunteers from the army; it was placed under command of Major v. Lossow, formerly commander of the Second Naval Battalion at Wilhelmshaven. The four chief and twelve under officers were taken from the two battalions, half from each. Its colors are those of the first naval battalion. The 200 men in the company of marine artillery were drawn equally from the four divisions of marine artillery at Friedrichsort, Wilhelmshaven, Lehe, and Cuxhaven. In addition to this there are 50 field and 25 foot artillerymen. Capt.-Lieut. Franz Grapow, formerly navigator of the "Wörth," is commander of the company. For the company of pioneers one man was supplied by each battalion of pioneers in the army. The Lloyd steamers "Darmstadt" and "Krefeld" were appointed to transport the expedition from Wilhelmshaven to China. It consists of 1,500 men, while the cruiser squadron, including the "Kormoran," has 2,160 men, so that Vice Admiral v. Diederichs has a fighting force of 3,600 men at his disposal.

For the accompanying engravings and the data given above we are indebted to the Illustrirte Zeitung and Ueber Land und Meer.

SHIPBUILDING IN JAPAN.

IN a report to the Foreign Office on the trade and navigation of Nagasaki (Foreign Office, Annual Series 2,004) H.M. consul at that port states that considerable extension was made in 1896 to the dockyard and engineering works in Nagasaki, the largest dock having been lengthened so as to be capable of receiving ships up to 500 feet in length, and the construction of a new dock of a length over all of 371 feet having been completed. Very extensive additions were made to the moulding, boiler, and engine shops, and all modern machinery provided that was necessary to render the works efficient in the highest degree. A large machine shed for iron workers, and new sawmills and joiners' shops are now in process of construction, and all the valuable machinery required for them has already been ordered from England. Designs are also in hand for a graving dock of the largest size.

These works, carried on under liberal and enlightened management, with the assistance of European experts in all branches, long since acquired a high reputation for good and economic workmanship in the docking and repairing of vessels of every description and nationality, from ironclad cruisers of the first class down to coasters, and many small steamers for coasting trade in Japan have been built and completed with engines, boilers, and all fittings.

During the past year more ambitious undertakings were started, and the building of ocean-going steamers for the first time undertaken. One steamer of 1,500 tons registered tonnage, built under the strictest requirements of Lloyd's special survey, for one of the principal shipping companies of Japan, has already been completed, and was successfully launched early this year, and another of 6,200 tons registered tonnage, with a speed of 12½ knots, is now under construction, and far advanced toward completion. The latter is being built for the National Mail Steamship Company (Nippon Yusen Kaisha) on precisely similar designs to those on which steamers have been recently constructed for the same company on the Clyde, and the result of this experiment, as to whether she can be completed in Japan at no greater cost than she could be delivered here if built in England, is awaited with much interest by the Japanese themselves. The best hopes entertained were that her cost would be no greater, but as many special expenses had to be incurred on her account, it is equally hoped that if this result is attained in the present instance, much better ones will, with the aid of the experience, be attained in the next.

Before the present experiment could be commenced at all, considerable alterations had to be made in the arrangements of the yard, so that the machinery necessary for laying the frames and beams of so large a vessel could be suitably placed. New furnaces and sheds had to be built, and workmen, hitherto accustomed to deal with frames of, at the outside, 3 inches in diameter, taught to deal with those of 6 inches, with proportionate increase of length and weight. The services of a distinguished English shipbuilder were engaged, and under his superintendence the construction of the vessel is now proceeding, it being the desire of the Japanese to turn her out complete and ready for sea in no longer time than that in which the same result could have been obtained on the Clyde. So well satisfied are they with their present progress that material is now being ordered from England for a second vessel of the same type and dimensions for the same owners, and the Japanese may, therefore, be said to be now well started on a career of ocean steamship building.

Two other large steamers are now in progress of construction, one a steamer of 2,500 tons in frame; but this vessel being intended for the owners of the yard, work is temporarily suspended in favor of the steamers building to order. The keel of another vessel intended to be used as a training ship by the Tokio Mercantile Marine School is also laid. The latter will be a sailing vessel with auxiliary steam power capable of a speed of 6 knots, built of steel, with cellular double bottom throughout its entire length, of 1,540 registered tonnage, and 238 feet in length. Designs are also in preparation for two salvage steamers, to be built principally of wood, but with bulkheads and ballast tanks of steel, and a large amount of work is being done as well in the construction of steam launches and general repairs. Under the latter heading 24 vessels of war of various nationalities, of an aggregate tonnage of 63,104 tons, and 65 merchant steamers, of 190,668 tons, were docked during the year, and 36 vessels of 21,047 tons placed on the slips.

In connection with the above, the Japan Weekly Mail publishes the following particulars of vessels of various sorts now being built for Japan in other countries:

Line-of-battle Ships.

Name.	Tonnage.	Place of Building.	Date of Expected Completion.
Yashima		Lord Armstrong & Co.	Finished and en route for Japan.
Fuji		Thames Iron Works	Ditto.
Shikishima	15,140	Lord Armstrong & Co	October, 1899
Asahi	15,140	Clyde Shipbuilding Yard	October, 1899

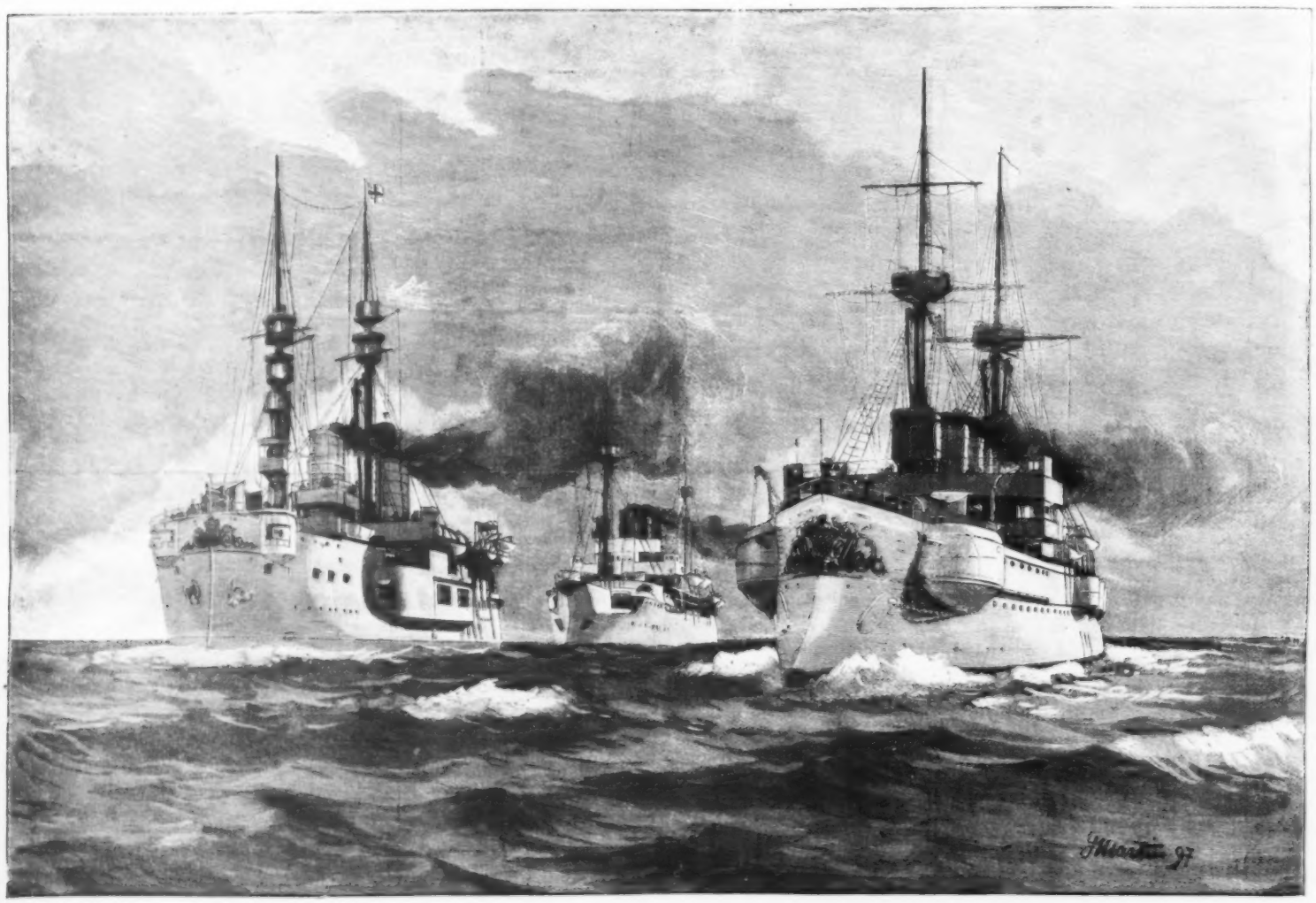
First-Class Cruisers.

Yakumo	9,800	Germany, Stettin	April, 1900
Azuma	9,800	France	April, 1900
Asama	9,800	Lord Armstrong & Co	July, 1898
Tokiwa	9,800	Lord Armstrong & Co.	September, 1898

Second-Class Cruisers.

Takasago	4,850	Lord Armstrong & Co.	February, 1898
Kasagi	4,850	Philadelphia Iron Works	December, 1898
Chitose	4,850	San Francisco Iron Works	December, 1898

It appears that the date of the completion of all the vessels now building in England for Japan has been deferred by two or three months owing to the strike of the engineers. One fact brought out very clearly by the above list is the rapidity of shipbuilding in England compared with any other country.



First class Cruiser "Deutschland" (flagship). Third-class Cruiser "Gefion." Second-class Cruiser "Kaiserin Augusta."

SECOND CRUISER DIVISION FOR THE SQUADRON IN CHINA.

OPTICAL GLASS.

SUPPLEMENTING the address of President W. R. Warner on the "Telescope Considered Historically and Practically," delivered at the recent convention of the American Society of Mechanical Engineers, was a paper by John A. Brashear on "Optical Glass," an abstract of which (The Iron Age) follows:

THE INVENTION OF SPECTACLES.

It is difficult, indeed, to trace the history of optical glass in its earlier development. I have studied almost every available authority on the subject, and have concluded that no great weight can be placed upon many of the earlier stories told us. Mollineux, in his "Dioptrica Nova," written in 1690, says: "That the ancients had no knowledge of optical glasses is most evident from their universal silence in this matter, their most learned and inquisitive philosophers making no mention or at least hint thereof in their writings. And doubtless a contrivance of that universal use, beneficial to all old men, both in reading and writing, could not have been so concealed as that the least footsteps thereof should not remain to posterity. The only relief they had for their decayed sights were certain colyria, or eye salves, and when they failed them they were left alone in the dark for minute and close objects." In an Italian work, published but five years

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before the remarkable work I have referred to, there is a statement that spectacles were invented about the year 1150, but this date is probably too early. It is, however, quite certain that the date of the discovery of lenses, as applied to spectacles, is somewhere between 1280 and 1311. In a manuscript preserved in an Italian library, written in 1299, there is a sentence which, translated into English, reads thus: "I find myself so pressed by age that I can neither read nor write without those glasses they call spectacles, lately invented; to the great advantage of poor old men when their sight grows weak." Friar Jordan, in a book of sermons printed in 1305, tells his audience that "it is not twenty years since the art of making spectacles was found out, and is indeed one of the best and most necessary inventions in the world." From this and much other data it is quite certain that spectacles were known in the latter part of the thirteenth century.

After a great deal of research I have failed to find any satisfactory data as to the character of the glass used in making spectacle lenses. That it was crown glass there seems little doubt, for the reason that all flint glass made during this period was very impure; indeed, up to the beginning of the present century no flint glass had been produced that was of any value for optical purposes.

Through the courtesy of Admiral Mouchez, director of the Paris Observatory, I was permitted, in 1892, to examine some of the largest objectives made by Divini, of Rome, and Campani, of Bologna, about the middle of the seventeenth century, one of which was 6 inches in diameter. I am quite sure that the material out of which these lenses were constructed is similar to the mirror glass manufactured at the time they were made. If my memory serves me right, the 6-inch lens was not over ¼ inch in thickness. I well remember examining the object glass used by Cassini, with which he discovered the double ring of Saturn. It was about 4½ inches in diameter and not over $\frac{3}{16}$ thick at the edge; and as the radius of curvature was, I should say, not less than 40 feet, the lens was very little thicker in the center than at the edge. Owing to the many little scratches on the surface of this historic glass, I was not able to determine the character of the material in it, but it must have been of fairly good quality, or Cassini could not have made such discoveries with it.

A new era in telescope making dawned upon the world when Dollond made his wonderful discovery of correcting the chromatic aberration of the object glass. But Dollond's discovery required the use of both crown and flint glass. Crown glass of fairly good size could be procured by a careful selection of the best grades of plate glass, but flint glass of sufficient purity could not be obtained for objectives of more than 3 to 3½ inches in diameter, and then only by chance could pieces be found by searching through a large mass of material at the glass works. So serious did the problem become that the Academy of Sciences at Paris offered a prize to the successful maker of flint glass for optical purposes. Macquer, a celebrated chemist; Roux, of the great St. Gobain glass works; Albert, of the Langress glass factory, all tried to solve the problem, but failed completely, and it is stated by Bontemps, one of the best authorities on the manufacture of glass, that out of 100 pounds of the best flint glass any of the makers could produce, they were often unable to get the material for an objective of 3 inches in diameter, and at this period—about 1811—a piece of good flint glass 3¾ inches in diameter, free from imperfections, was considered of great value. In an old and very rare book by Dr. Kitchiner I find the following note: "I am informed by the Messrs. Dollonds that between the years 1760 and 1765 they met with a pot of uncommonly fine flint glass. Crown glass was also then to be had of much superior quality than they had been able to procure since the cessation of the glass house of Ratcliffe —however, they found that they could not even then with these confessedly superior materials produce an object glass of larger aperture than 3¾ inches. Such was the case then when it was much more plentiful than it is now." This note, written in 1818, shows that it was a mere chance melting of glass that gave the Dollonds their opportunity to make lenses of so large an aperture as 3¾ inches.

But the time had come that with the want came a man to supply it; and, like many of the most valuable inventions that have opened new eras in the world's history, this one came from where it was little expected. Pierre Guinand, a watchmaker of Brenets, near Neuchâtel, in Switzerland, had learned of the difficulty of making flint glass; and, although he had no knowledge of the processes employed, ignorant in a great measure of the laws of physics and chemistry, he attacked the problem in a variety of ways, each time gaining knowledge that was invaluable to him. He seemed to be endowed with the spirit of research, coupled with great perseverance and patience; and, although he worked years without results, success finally came to him.

"CONTRE ADMIRAL" PRINCE HENRY OF PRUSSIA, CHIEF OF THE SECOND DIVISION FOR THE SQUADRON IN CHINA.

MAKING FLINT GLASS.

There are two serious difficulties in making flint glass; one is that of a tendency of the oxide of lead—which is one of the important constituents of this glass—to fall to the bottom of the pot or crucible when it is in a state of fusion. This tendency of the lead oxide to sink produces unequal density in the various horizontal layers of the glass, which in itself would not be so important if it were possible to cut truly horizontal sections from the cooled mass; but this is, in the very nature of the case, an impossibility, for in cooling, the glass breaks up into more or less irregular shapes, and from these pieces must be selected the material for lenses. Another and most serious difficulty is to get rid of striæ or chords in the glass, which requires a very perfect mixture of the fluid mass, but which is rarely ever attained.

Guinand's process is essentially as follows: A single pot or crucible, made of very pure clay, with an opening in the side near the top, is placed in a furnace especially arranged so that the heat can be applied all around it and as equally as possible. The material for the glass is placed in the pot or crucible in two or three charges, separated by an interval sufficient to allow the previous charge to settle. The material, or batch, as it is technically called, is now thoroughly melted, requiring about thirty hours of perfect fusion, a very high temperature being required. Tests are taken from the melted material from time to time until the test pieces show not only perfect fusion but the greatest possible freedom from air bubbles. At this stage of the process, Guinand's invention is brought into requisition, namely, a thorough stirring of the fluid mass. For this purpose a stirrer, made of the purest clay, is introduced into the pot, having been previously brought to quite a high temperature so as not to chill the glass. This stirrer, called a Guinand, is so made that an iron handle can be secured inside of the upper end of it, the long handle of the iron part being carried in a bracket on the side of the furnace so as to carry its weight. The process of stirring is now commenced and is a most laborious task, not only on account of the character of the work, but of the excessive temperature that must be endured by the workmen.

Two men are required to do this work, as it must be kept up for about three hours, or until the mass has become so stiff that the stirrer can no longer be moved by the operators. The temperature is allowed to fall during this and subsequent stirrings, so that the metal may approach so nearly to the solid state that the metallic oxides will not sink. For the commoner grades of optical flint glass, one stirring is usually considered sufficient, but for the best grades the temperature is raised after the first stirring, and a second and sometimes a third stirring is found necessary to work all the remaining air bubbles to the top, as well as to so thoroughly mix up the mass that it will be of as nearly as possible the same density from top to bottom. So difficult is it to move the stirrer toward the end of the process that the Guinand, or clay stirrer, cannot be moved around the pot in less than six to seven seconds. No doubt mechanical methods could be devised for this part of the work. The iron handles of the stirrer must be frequently changed on account of becoming so hot as to form scales of gray oxide, which, if they should fall into the glass, would ruin it for optical purposes. One of the greatest difficulties the optical glass maker has to contend with is the presence of iron in the clay from which the pots or crucibles are made.

After the final stirring has been completed, double covers are placed over the mouth of the pot and carefully luted with clay. Every avenue for the ingress or egress of air in the furnace is carefully sealed and the furnace, pot and glass allowed to cool during a period of six to ten days, according to the weight of the melted mass and size of the furnace.

ANNEALING GLASS.

The front of the furnace is now taken down and the crucible drawn out in order to get at its contents. The pot is usually found pretty well shattered, and is broken away from the now solidified and cooled mass within it. The glass is also found broken into irregular lumps of greater or less size, but all are carefully examined and set aside for use according to their value.

Just here comes in the second process discovered by Guinand, a process invaluable in the art of optical glass making, and which is used to-day almost exactly as it was in the days of its illustrious discoverer or inventor. Let us suppose a lump of this glass is selected that has weight enough to make a disk 12 inches in diameter. It is first ground and polished in places that will allow of a careful inspection of the interior of the mass. It is rarely that a lump of such size is free from imperfections, some of which may be in the very center of the piece chosen. A careful diagnosis having been made, the impurities are ground or cut out by various methods, and after all defects that can be reached have been eliminated the lump is ready for the third stage, namely, that of softening it down to a disk of the proper diameter and thickness. In this work the most scrupulous care is necessary, for if the lump be as pure as crystal quartz and does not go through this third stage as it should, it will be useless for the purpose of making a fine object glass.

A special furnace is constructed which is called the annealing oven, in the center of which a mould is placed of the size necessary to make the required disk. This mould is of clay, which for disks of large size is so made that the ring which forms the thickness is separated from the flat bottom. The ring is also made in two pieces and secured by a wire wrapped around a groove on the outside, so that the annealed disk may be easily taken from the mould when it becomes cold. To prevent the disk from sticking to any part of the mould, it is first painted over with mucilage and then dusted with pulverized chalk. The lump of glass is now laid in the mould and a cover of clay is placed over it and the glass so that no flame can strike it directly. The temperature must be raised very slowly, so that the lump of glass will not crack, for if once cracked it is ruined. It may be of interest to know that a lump of glass may be sawed or cut almost in twain, and, if placed rightly in the mould, make a perfect disk, as when softened by heat the part that has the cut in it will slowly float to the top, solid glass taking its place; but if the cut extends through the lump, it coalesces without rising, making the disk useless. The temperature of the annealing oven need never be any greater than the melting point of glass, which, of course, varies with the different kinds of flint and crown. The muffle, or cover, that is placed over the mould is so made that it may be removed at any time by an iron fork, through a small opening in the furnace, so as to examine the glass.

It is necessary that the temperature should be kept quite constant until the glass has become evenly heated throughout and until all depressions have arisen to a common level. It is almost imperative that the sides of the annealing oven should be so constructed in relation to the mould that the cooling shall be symmetrical, else the disk will be certain to show the effect of irregularity of cooling. It has been found that in annealing glass the temperature may be brought down rapidly without any danger, until it reaches a certain critical point, which I believe has not been accurately determined, but which, from some experimental data, I am inclined to think is not far from the point of incandescence, about 997° F. or 523° C. Before this critical point is reached, the annealing furnace must be rigorously closed to all infusion of air, and as for large disks the furnaces are quite massive, the process of cooling goes on very slowly, allowing the molecules of the glass to find their normal positions, or, as it has been very prettily stated, "to lie kindly in their relations with one another." The cooling process is necessarily very slow, and for large disks requires from ten to twenty days. Smaller disks and plates require less time. For forming and annealing small disks and plates, the inner edges of the moulds

are beveled to allow the annealed glass to drop out readily after it has become cold.

After the first annealing, the disk is ground and polished on the faces, again examined for imperfections and the quality of the annealing. If imperfections such as striæ, chords or stones are found in the glass, they must be ground out and the disk must again go through the same process. A second or third annealing is fraught with new dangers, the principal one of which is that of devitrification, i. e., changing of the glass from the transparent to the translucent or opaque condition, thus making it useless for any purpose whatever. The writer has seen a beautiful 30-inch disk ruined in this way; but, fortunately, devitrification rarely happens with the careful workman.

These processes, as worked out by Guinand, are practically the same as those used to-day. Some improvements have been made by Feil and Mantois, of Paris, who have made the magnificent disks of all the larger objectives made in recent years. Dr. Schott & Company, of Jena, have also added some features to the annealing process, which have yielded splendid results so far as freedom from molecular strain is concerned. Since the days of Pierre Guinand many new kinds of glass have been discovered and made by the French and German glass makers, some of which have proved to be of the highest value to the optician. To Dr. Schott, Dr. Abbe and Dr. Zeiss, in Germany, MM. Feil and Mantois, in France, we owe a debt of gratitude for their invaluable services in this important work.

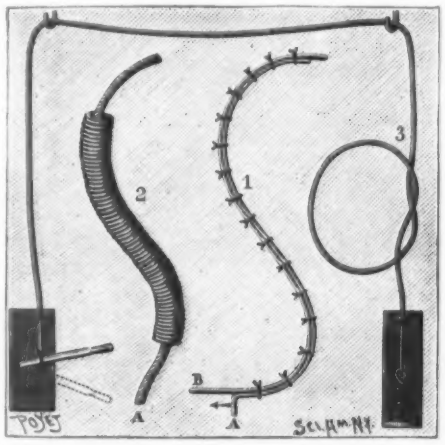
But our disk has not yet passed through the entire gauntlet it must run before being pronounced fit for a great objective. All disks are sent to the optician with a guarantee of their perfection. This "doubting Thomas" now repolishes the surfaces and with his polariscope examines the glass for strain. If the annealing has not been regular, the telltale polariscope has no mercy, but picks out the defects with unerring certainty. Should it pass this ordeal, it must then be subject to a careful study for striæ and unequal density. To locate striæ, if they exist, a beam of light is concentrated by a lens on the various portions of the disk, every inch of which is carefully studied; the keen eye of the observer rarely failing to detect any striæ or chords that would do harm. Unequal density is a far more difficult thing to detect, and unless it is of a pronounced character (something unusual in the present state of optical glass making), it cannot be detected until the objective has passed the stage of grinding and polishing.

If the density is but slightly different in the various areas of the glass, it may be corrected by a system of local retouches well known to the practical optician, but if there is a marked difference in the density, the disk must be condemned and returned to the manufacturer, as it is useless to undertake to make a good objective from it.

MODEL OF A WOODEN BRIDGE OF A SINGLE SPAN THAT MAY REACH A LENGTH OF ONE HUNDRED AND FORTY FEET.

A GLANCE at the model of this bridge will suffice to make known the contrivance without the necessity of any other explanation. So I shall be content to say that the springings of its arch must be very solid. I mean to say that the ground on both sides of the river upon which the arch is to abut should be rock, or else should be fortified by masonry.

According to the width that it is desired to give this bridge, its arch will be composed of three, four or five rows of girders that will be made to abut against each other, as shown in those marked A, B, C, and upon each of these rows composed of three girders there will be placed two other girders similar to D and E, which, being longer than the first, will abut through the center of the arch. All these different girders will be connected in all parts by straps and iron pins, and by good cross beams; and as the cross beams of the sides are strengthened by other pieces of wood that cross them,



TRANSMISSION OF MOTION BY A FLEXIBLE WIRE.

they will be able further to serve not only as a guard rail, but also for sustaining its roofing, should that be desired.—From Recueil d'Ouvrages Curieux de Mathematique et de Mecanique, 1733.

TRANSMISSION OF MOTION BY FLEXIBLE WIRE.

As is well known, it is generally impossible, without special contrivances, to transmit ever so feeble a power between the two extremities of a slack flexible wire, especially when the latter has to follow a tortuous course. The problem has been solved by means of the classic bell cord and crank, the origin of which is very ancient, but the process is costly, complicated and devoid of elegance, and the invention of electric bells has caused it to fall into desuetude. There are many cases, however, in which it would be advantageous to be able to transmit a slight stress in order to ring a bell, etc., without having recourse to the unsightly cord, or to electricity, which necessitates the use of a battery and an electromagnet. This may be done by means of a simple and ingenious arrangement devised by Mr. Ernest Bowden, and the principle of which may be understood by a reference to the accompanying figure. If we take a flexible wire, it will be impossible to transmit the least stress between its two extremities, but if we juxtapose two flexible wires and make them interdependent here and there, we shall be able, upon giving a motion to one of the extremities, to transmit the same to the other, despite the flexibility of the wires and the fact that they are free and floating in space.

In practice, it is preferable that one of the wires shall be inextensible and the other incompressible, and the best results will be obtained in arranging the two wires concentrically. To this effect, the external wire is wound in juxtaposed spirals and the inextensible one is arranged in the interior of the tube formed by the spiral of the external wire. The interior wire then works within the tube, the two extremities of which are carefully fixed. The tension exerted upon the internal wire is thus freely transmitted, even when the external wire is left floating or even when a loop is formed in it. It is thus possible to exert an action to a distance by fixing the double wire permanently in place like the wire of an electric bell.

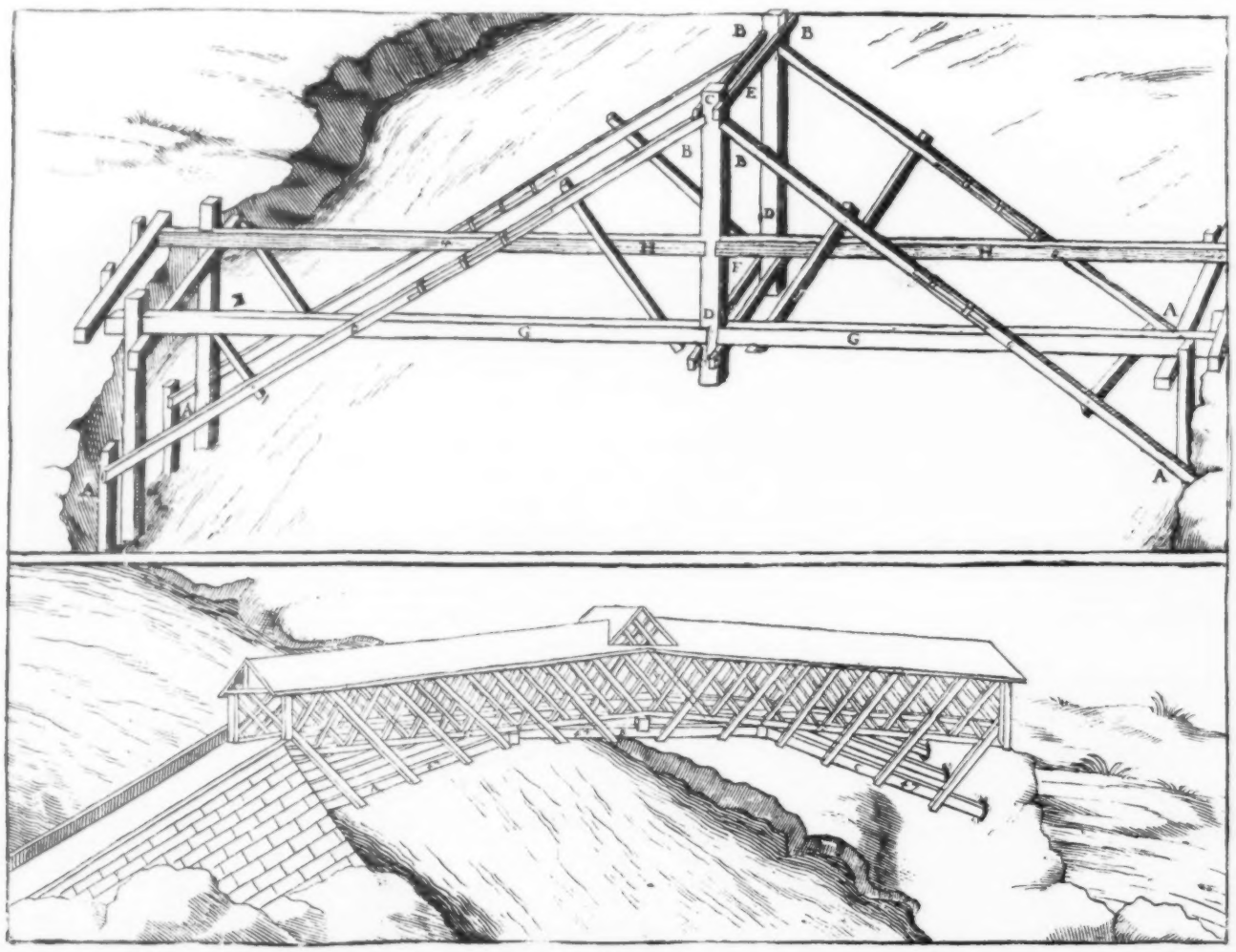
The inventor devised this system with a view to transmitting motion to a bicycle brake, but it will be seen by this short description that its applications are infinitely varied.—La Nature.

THE SMITHFIELD CLUB SHOW.

THE ninety-ninth annual cattle show, held under the auspices of the Smithfield Club, was opened at the Agricultural Hall, Islington, recently; and, in accordance with precedent, there was, in addition to the unrivaled exhibition of live stock there, a goodly array of the agricultural machinery for which our eastern county engineers in particular have established such a high reputation.

Messrs. Clayton & Shuttleworth, of Lincoln, show some novelties at their stand. Among these we may notice the 4-foot 6-inch portable finishing thrashing machine, to which they have now attached a small grist mill at one side, which is driven from the drum spindle. With this mill small and inferior grain, of which there is always more or less, can be converted into cattle feed while the thrashing is proceeding. Another feature in this thrashing machine is a new beater drum, in which the ribbed beater plates are fixed to the beater bars without the ribbed-headed bolts formerly employed. The firm also exhibit a highly finished general purpose traction engine, which we also illustrate. The cylinder is 8 inches in diameter, and is fitted with a bored guide instead of the usual four bars, which, indeed, show signs of entirely disappearing from all first-class engine works.

The first motion gearing is placed in the box brackets in the usual manner common to four-shaft engines; the double spur wheels for giving the two speeds slide on a square shaft. A case-hardened ball-and-socket joint on the fore carriage reduces the friction to a minimum, and enables the steering to be effected with facility and certainty. The steerage hand wheel is placed on the flywheel side; the steersman can see the side of the road, the hedge or ditch when passing vehicles; and the flywheel is more readily placed in line with the machine pulley to be driven when the steerage wheel is thus fixed. A slip-winding drum is

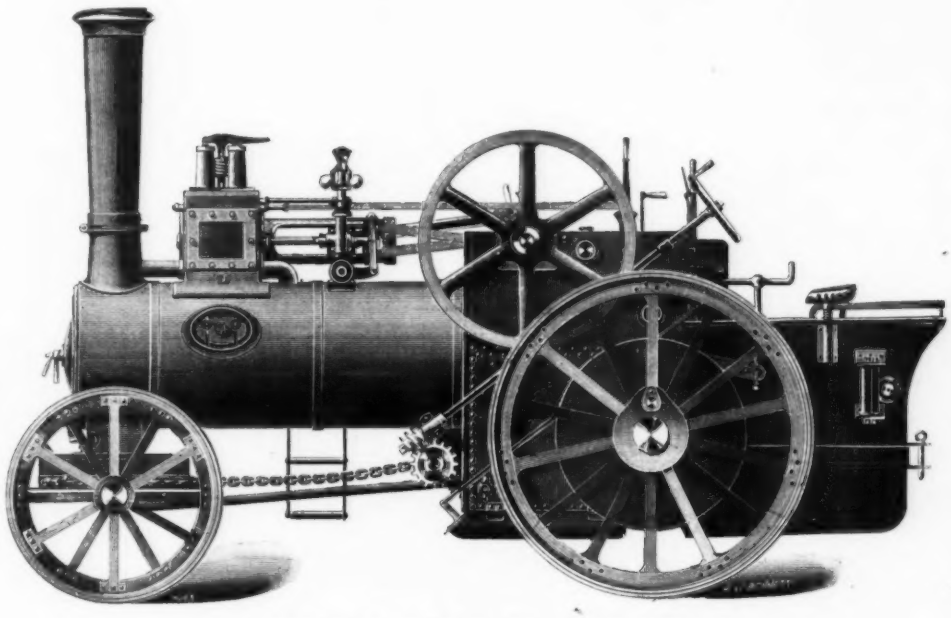


MODEL OF A WOODEN BRIDGE OF A SINGLE SPAN THAT MAY REACH A LENGTH OF ONE HUNDRED AND FORTY FEET.

mounted on the boss of the brake drum. A circular box is fitted to the fore axle for the steering chains. The workmanship throughout is of high quality, no black bolts being used, but each is turned to a driving fit and hammered home into place. The boiler is designed for a working pressure of 150 pounds per square inch, and with this the engine is capable of developing over 30 brake horse power.

Another novelty at this stand is a high speed vertical oil engine, which is of the automatic type, that is to say, when once started, the engine requires no external flame to effect ignition or gasify the oil. The vaporizer is placed on the top of the cylinder and is heated at the commencement by a couple of lamps, which at the same time heat an external ignition tube. When the engine is started the lamps are removed, and the successive explosions maintain the vaporizer at the requisite temperature, and at the same time heat to the proper ignition point an internal igniter which explodes the charge each working stroke. This internal ignition needle is carefully insulated with asbestos, so as to diminish the loss of heat from it by radiation or conduction, and insure that its temperature shall be maintained to the proper ignition point. The oil pump is worked by a striker on the air valve spindle and is fitted with a simple hit-or-miss inertia governor. The stroke of the pump and the lift of the air valve are both adjustable.

Arrangements are made at the camshaft by which at starting the closing of the exhaust valve is delayed till one-half of the compression stroke is completed. This much reduces the difficulty in starting, and once the engine is fairly away the valve motion is easily changed over to its normal position. A water circulating pump is fitted to the base of the engine.—Engineering.



TRACTION ENGINE FOR ROAD USE.

CONDITION OF THE HORSELESS CARRIAGE INDUSTRY.

By C. E. CORRIGAN.

IT is to be remembered that before entering this field of enterprise one obtrusive fact demands and must receive due attention—the fact that there never was a great discovery or a valuable invention or any other really good thing that did not go a-begging for recognition among experts and the general public and have to fight its way to acceptance.

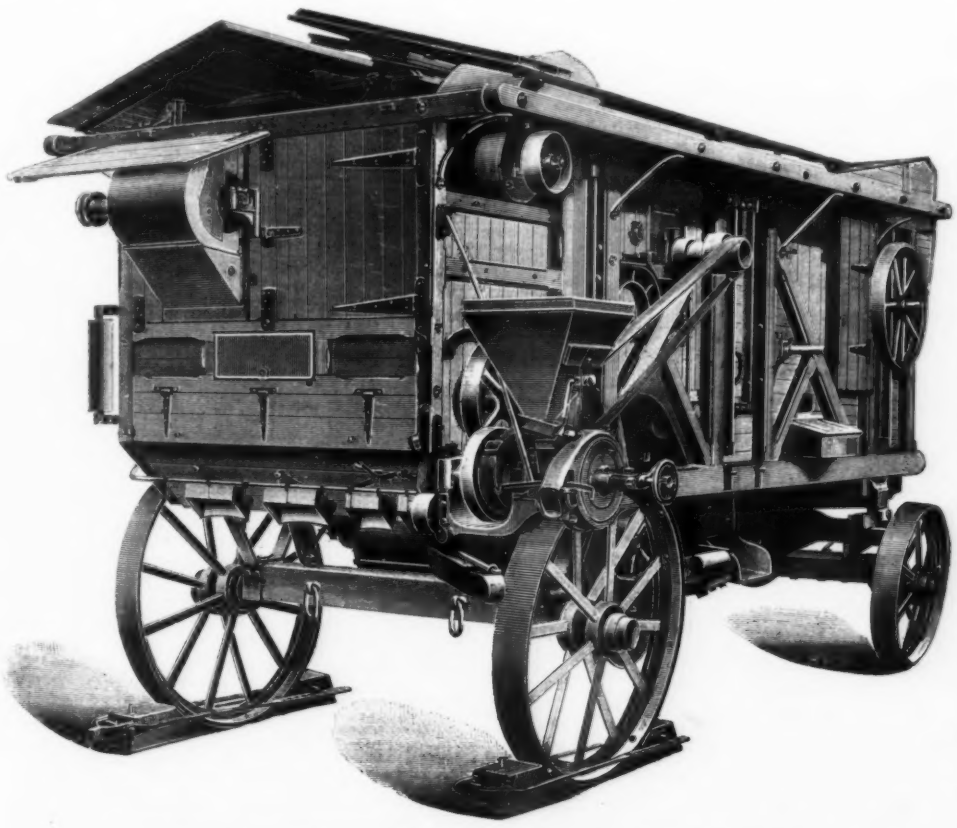
But our difficulties have already been largely overcome. Those primitive motive powers, the patient ox, the mule and the horse, have been deposed in many fields of transportation and their successors have been and are being supplanted in turn by electricity, and people have begun to realize that electricity is the natural medium for the application of motive power. Its supply is unlimited. It is everywhere. It is to movement what the sun is to growth.

Meanwhile other methods and materials for producing power for horseless vehicles are seeking recognition. The gasoline and gas engines have and will have for some time to come a distinct field of usefulness, and they aid very materially in increasing and intensifying the demand for good streets and roads, the want of which constitutes one of the difficulties that is being overcome. The more populous the territory and the more enlightened the population, the better the roadways. All these wants are working together—in these days very rapidly—toward fruition. The good roads question is a very live one at this time. For this the horse will also be thankful. Certainly, we have to combat a greater or less sentiment in his favor; and we do it with poor grace, for he who does not appreciate a horse lacks something of being a man. Nevertheless, it is true that the horse is a much overloaded and abused animal. The meanness of mankind is illustrated in the too heavy load, the too long journey and the bad roadway, and the horse is beaten or encouraged into meeting these conditions and supplying all deficiencies. Some of his admirers might easily think that it is time he was relieved somehow from as much of this surplus of burden as constitutes cruelty. Good roads will help both him and his owner. Certainly there are places where we cannot altogether spare him. There could be nothing inspiring in the sight of a plump and splendid brigadier-general waving a battle-scarred flag and cavorting around at the head of his troops on a bicycle; and yet there are a few young people of various ages who think the bicycle, too, has its place, and they, likewise, favor good roads.

One of the difficulties we have been overcoming is involved in the tire question, which it was the province of the bicycle to develop. True, the making of tires is an independent field, but the result is important to us. After long and thorough tests on passenger and freight vehicles, we find that for the luxurious family carriage or the buggy, and with smooth, clean pavements, the pneumatic tire is the proper thing, but for parcel delivery wagons, under more or less strain of burden or roadway, the cushion or the solid tire is much better, and both meet their own conditions effectively. It took a little time to learn this, because the public always demands extreme conditions—the utmost immediately. But this, again, encourages effort and helps progress. For instance, customers asked us for a vehicle that would run all day with one charging of the batteries—and this must not increase their weight. To meet these conditions we succeeded in getting batteries that will run a wagon on fair roadway from forty to sixty miles a day with one charging, while at the same time of about one-third the weight and bulk of anything else we have been able to learn of. With frequent stops and over various sorts of roadway the wagons now in use for several months by a prominent silk merchant of Chicago have averaged per wagon thirty-seven miles per day, as registered by the rodometer. This method of ascertaining distances is one the owners of horse delivery wagons should adopt before too positively stating the totals. The owner says that the electric wagons travel much faster, stop quicker, start easier and do much more work in a day than any horse wagons he has had experience with.

All the same, this is an extreme test. The last part of a discharge is more wearing on the batteries, and it is always more satisfactory to have plenty of power in reserve. A given amount of force is more effective if backed up by a surplus of volume. The daily working and the overworking of a man's muscles or his brain illustrate this truth; therefore, we have found it economy to use duplicate sets of batteries or to recharge the one set, say at noon, when the horse would be eating. Nature is always making valuable suggestions which help us to overcome difficulties.

Direct current of one hundred and ten volts can usually be obtained, but for livery stables or large mercantile houses a gas engine and generator will be found more economical. A difficulty now being rapidly overcome is the want of a sufficient number of large power supply plants, which will reduce the expense of current to the minimum. No doubt the needed plants will prove very profitable investments, so very general and various are the uses to which electricity is being applied. A gentleman, who probably has as much capital invested in such power plants as any man in this country, told me that electric power could be profitably produced and delivered at a cost of one cent a kilowatt hour—a statement which I confess astonished me and the correctness of which I could not have accepted as probable had it come from a less reliable and disinterested authority. This being a utilitarian age, in which the greatest economy in producing the greatest result is the all important question, such a fact as the above seems to contain in itself the rapid solution of our remaining difficulties.—Western Electrician.



THRASHING MACHINE RECENTLY EXHIBITED IN ENGLAND.

EFFECT OF ELECTRIC CURRENTS ON ADJACENT AND SURROUNDING BUILDINGS.*

THE old familiar question, What is electricity? that is asked in every text book on electricity, and is answered by saying that it is an imponderable fluid capable of traversing the air, the earth and especially all metals, and for commercial purposes flows through iron or copper wires in an invisible fluid state, has no foundation in fact; but advanced electrical scientists to-day recognize no such theory and are free to admit that the exact nature of electricity is unknown. The sources of electricity, such as are termed frictional electricity, hydro electricity, pyro electricity, magneto electricity, thermo electricity, animal and vegetable electricity, etc., are not different kinds of electrical force. Electric force or energy is of one kind only, no matter from what source it may originate. With these denials we are brought to our belief, and to give force to the same we call your attention to the wonders of creation. The visible and invisible worlds; the mightiness of the planetary and stellar systems; our world and all that it contains, and the unseen force that regulates the movements of all that is contained in the whole universe, from the largest planet to the smallest atom of dust, each and all are under one law, one force. This law has no deviation; it is the same for a part as for the whole. In order to well understand this law, it is necessary to consider the atomic theory, the theory of atoms.

By this theory of matter we are told that all substances, either fluid, gaseous or solid, are made up of atoms. These atoms are the ultimate diminution of each particle; that the atoms are absolutely unalterable in size, shape, weight and density, and are unaffected by any known physical force, but nevertheless possess a definite size and mass, and according to the latest authority the smallest particle of matter, 1-4000 of a millimeter in diameter, will contain about 30,000,000 atoms. This theory of atoms extends from the center of our globe to its surface and all things about the same to our atmosphere, and to all the systems of the heavens and its limitless region and to all things visible and invisible.

It is not possible in a report of this character to

* From report presented by committee at Thirty-first National Convention of the American Institute of Architects, held at Detroit, September 27, 1897.—From the Sanitary Plumber.

enter into a full explanation of the theories advanced; we can but call your attention to them in order to complete a chain of reasoning.

Our most important consideration is that of the ether that pervades every vacant space of the whole universe; it penetrates everywhere in the animal and vegetable kingdoms; everything that is organic or inorganic; pervades everywhere to the utmost limits of the limitless universe; it is the invisible medium that connects everything, from the minutest atom to the sun, moon, planets and stars of our own system and of all other systems, known and unknown. It is the medium in which they all maintain their position in space, sustaining them as they perform their various revolutions. This ether was in the beginning before the creation of the universe; it filled the limitless space that before was a void; it was the first creation.

This ether is a material substance of a more subtile kind than visible bodies and is totally different from the atmosphere that surrounds our globe.

The transmission of light, heat, electricity and sound are due to this ether medium. The atmosphere has nothing to do with it. Our atmosphere has its specific functions to perform perfectly independent of this ether medium, and it is to this ether alone we must look for the solution of the phenomena of light, heat, electricity and sound. Atmospheric air is a necessity for the production and maintenance of life in the animal and vegetable kingdom.

The true study of the distribution of heat must be made through a study of the ether medium, and also alone can we solve the great problem of acoustics only through a study of the ether medium, as also the study of light and electricity, all as in connection with the great problem of the life and existence of all buildings.

. . . . . .

We now come to the consideration of the effects of electricity or electric currents on the materials of buildings. The atoms of matter of all kinds in their natural or normal condition are at rest, and cohesion is perfectly maintained by the magnetic influence of the atoms on the envelopes of the atoms. A disturbance of any kind on material sets up electrical manifestations; it may at first be exceedingly minute, yet nevertheless it exists. Every operation in building, from the digging of the foundation, the erection of the walls and the covering in of the edifice and equipping of the same, is a disturbance. The mining of the metals that enter into the building is a disturbance; in fact, the making of the different kinds of materials, from the raw to the finished stock, is a disturbance. Everything that is done about a building or enters into its construction has been disturbed from its primitive rest, and from that moment of disturbance electrical conditions have been set up. The magnetic force of the atoms which induced cohesion have been at that moment displaced by electric conditions destroying cohesion and producing as an ultimate result disintegration and the dissolution of all things.

The atoms of matter in their natural condition which were at rest have, by this disturbance, been set in motion, and this motion never ceases until dissolution takes place.

The wiring of buildings for electrical purposes, such as heat, light and power, however well insulated, when electrified sets up by a sympathetic action a greater disturbance or agitation of the atoms of the materials and thereby decreasing the cohesive force of the atoms, and directly as the electricity in the generator and in the wires is increased, so is by sympathetic action the want of cohesion in the atoms increased. Rest does not restore cohesion once set up; it goes on until complete dissolution takes place. As a result, the greater the electric disturbance, the greater the decrease in cohesion in all matter occurs, and is inversely as to magnetic condition of the matter.

This subject of electrical currents on materials in buildings is one of the greatest interest to the profession, and when well investigated will prove to be a very destructive agent, particularly on iron and steel, and may be the primary cause of many accidents that have occurred in the failure of structural pieces in the skeleton construction.

ELECTRICITY IN COTTON MILLS.*

By W. B. SMITH WHALEY, Columbia, S. C., Member of the Society.

ELECTRICITY as a means of transmitting power has been considerably dealt with in several very able papers before this society; and it is not my purpose to take up valuable time in covering again ground which has been only too well and ably investigated, desiring to give only the results of my experience with electricity as a means of transmitting power in a cotton mill. Its many useful dispositions have been described fully, but in every case we lack direct comparison from actual practice which would picture it to us in its true commercial light. It is the purpose of this paper to attempt to describe from the actual operation of two plants working under as nearly identical conditions as two manufacturing institutions can—the one operated by rope transmission with heavy head shafts, sheaves, etc., and the other by means of motors distributed throughout the building. In one the actual operation of the steam engine is considered; in the other the current is supplied to the motors from the secondary switchboard or receiving station.

Many have considered electric transmission in the light of a source of power, and we often hear comparisons on it with regard to power costs which are very misleading. Some have been imprudent enough to assert its economy for power purposes in connection with uneconomical water power plants, as the means of making such developments commercially available; and several large plants for cotton mills have been developed on this line with such blindness as to their true commercial value from an economical standpoint that room is left for well founded skepticism of their true value when compared with the many other more economical installations which might have been effected. Electricity's true position, for power purposes, is that of a transmitter; and whatever the source of power, the point to be considered is its efficiency in connection with that source for transmitting purposes. Having settled that, our investigation then leads to its comparison with other well known methods of transmission.

For the purposes of this paper we will take up the investigation, by tabulated data, from the actual everyday operation of the plants. The period during which the conditions as regards the working load were approximately the same was between the 1st of April and the 25th of June, 1897, and we shall designate the two plants as No. 1 and No. 2. No. 1 is a steam-driven mill, having a steam plant geared up with ropes, heavy head gearing and large tapering shafts as such plants are usually geared up in the best practice of to-day. The steam engine is an 800 horse power Corliss cross compound, built in 1895, with cylinders 20 and 40 by 60 inches stroke, and a rope wheel 24 feet pitch diameter, grooved for twenty-six 1¾-inch ropes, weighing 35 tons. This engine is being operated at an exceptionally low cost per horse power for steam. There was in the mill during the period for which comparison of power is made 11,776 spindles and 720 looms; all the spindles and preparatory machinery were run full, but the looms did not average more than 682 per day. No. 2 is an electric-driven mill which rents its current from a central station and distributes it through a continuous reading wattmeter to four 150 horse power inverted motors bolted to the ceiling in convenient locations for economical distribution of the power, and belted to the shafting. The mill has been in operation since the 1st of January, 1897. This mill had in operation during the period named above on an average 12,448 spindles, with preparatory machinery, and an average of 356 looms out of 500 in the mill. The weight of the shafting in the steam mill is approximately 136,000 pounds and in the electric mill 122,000 pounds.

POWER IN EACH MILL.

From the diagram showing the power curves in the two mills during the period alluded to, we find that the average in the steam mill is 535·71 horse power for all purposes (this mill is only partly filled with machinery and is using not quite two-thirds of its full power). From indicator cards taken, we find that the power required to drive the shafting and belting on loose pulleys only is 228 horse power; for the 720 looms and shafting, only 349 horse power; and for the whole mill, 595 horse power. Deducting the friction horse power from the power required to drive the looms and shafting and dividing this result by the number of looms, we obtain the power required to drive one loom, which is 0·168 horse power.

Deducting the power required to drive the looms and shafting from the total power gives us 246 horse power, which is the power required to drive the spindle and preparatory machinery. This amount divided into the number of spindles gives us 60 spindles per horse power, including the necessary preparatory machinery for this number of spindles.

At the time the data given above were obtained, there were in operation in the mill 14,848 spindles, with the necessary preparatory machinery and 720 looms.

In the electric mill, owing to the lack of suitable instruments for testing the separate motors, we were unable to find the amount of power expended in friction, and consequently, having only the average power consumed, we can compare the mills by using the data obtained from the steam mill to bring the electric mill to the same basis. From the power chart we observe that on an average 418·2 horse power per day were used in the electric-driven mill during the period above alluded to, namely, from the 1st of April to the 25th of June. During that period there were in operation on an average 12,448 spindles per diem and 357 looms, as against the steam mill operating 11,776 spindles and 682 looms.

From the data obtained from the steam-driven mill we have the following distribution of power during the test:

	Total Power.	Looms and Shafting.	Friction.	Horse Power Spindles.	Looms.
For the steam-driven mill.....	535	340	226	196	114
For the electric-driven mill... ..	418	206	149	208	60

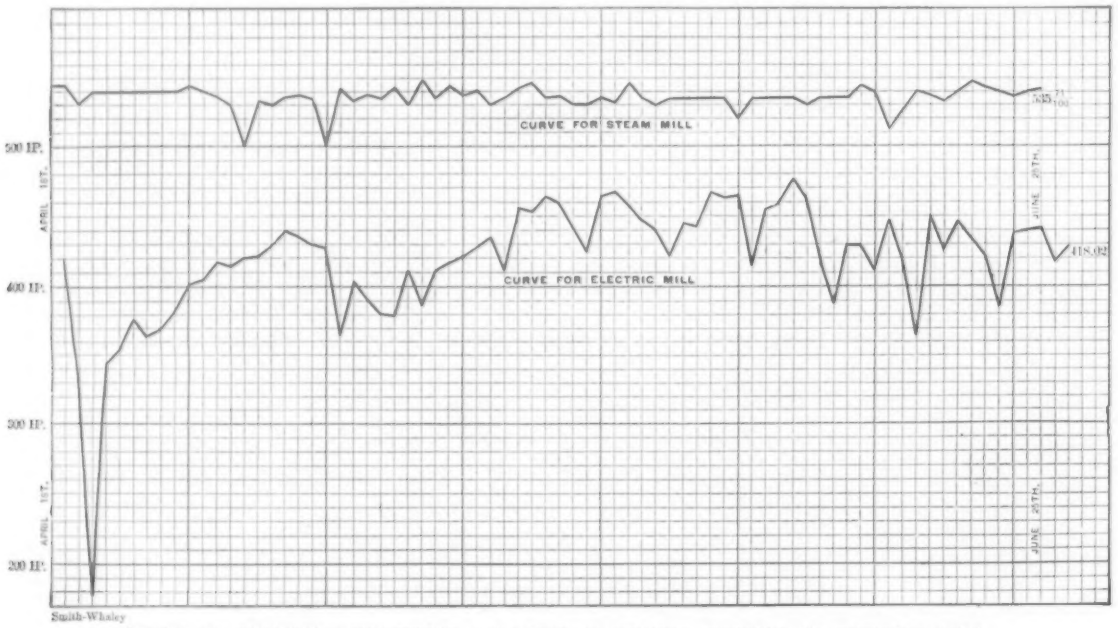


DIAGRAM SHOWING ELECTRIC AND STEAM POWER CURVES IN COTTON MILL.

Hence the difference between 226 horse power and 149 horse power, which is 77 horse power, must be credited to the electric mill in its present condition.

The following points from the foregoing can be stated as existing under the present conditions: the steam mill is operating under a disadvantage of an underloaded engine; the electric mill is operating under the disadvantage of driving more shafting per motor than it will when the full complement of machinery is installed.

The steam mill requires more supplies in the shape of oil, sizing for ropes, and other necessary incidentals due to the method of transmitting the power. The electric mill has cost nothing for its motors in six months of operation, not even the necessity of putting oil in the bearings, which was simply renewed once in that time as a precaution. The convenience of operating any section of the mill ad libitum, without reference to the other sections, is an advantage which is felt in dollars and cents in plants using the electric transmission.

The question which arises as to whether a generator directly connected to an economical type of engine to produce the power would consume the difference in the frictional horse power, is one which can only be answered from data from institutions having such plants. It is the author's opinion that this difference of power would not be exceeded, and he hopes subsequently to give more specific data from further experiment from the actual operation of these two plants under better conditions, viz., when both mills are completely filled with machinery and motors and engine run at their full load; also in obtaining the efficiency of direct connected engines and generators.

It must be borne in mind that, unlike a machine shop and other manufacturing establishments, where a large amount of shafting is required to cover the ground and where intermittent power is used, a cotton mill drives in useful effect 95 per cent. of its shafting and uses actually in continuous operation almost the maximum power at all times.

In presenting this paper the author hopes that it will awaken enough interest in others to induce them to collect and present to the society useful data which they may have relative to this very important subject.

*Paper presented at the New York meeting (December, 1897) of the American Society of Mechanical Engineers.

ENGINEERING NOTES.

The use of a roller in road making was first suggested by Cessart in 1786, and first adopted by Polinceau and Morandiere in 1835. The first steam roller was constructed by the French engineer Ballaison.—Oesterreichische Monatschrift.

The importation of aluminum into Germany during the first eight months of 1897 amounted to 669,000 kilogrammes, being nearly double the amount for the corresponding period of 1896 (360,800 kilogrammes). Switzerland supplied the bulk of the imported metal, viz., 546,400 kilogrammes. The United States imported 71,300 kilogrammes and France 33,300 kilogrammes.—Uhland's Wochenschrift.

In Para, Brazil, street cars are called "bondes," which is the Portuguese plural of the English word "bond." The origin of this curious term is its use in the posters on which the English companies which constructed the railways announced the sale of their bonds. As the people did not know English, they thought that the term "bond" had some reference to the street railways, and adopted this new word for the new thing.—La Vie Scientifique.

The small town of Totis, in Hungary, according to Engineering, claims being the first town which has introduced municipal lighting by acetylene gas. Not only streets and squares are being lighted in this manner, but also several houses, and on the occasion of the recent visit of the German Emperor the park of the royal shooting box, the effect being excellent. Among other places, Vienna is contemplating making experiments with acetylene gas lighting on one or two of the large squares.

The annual cost of maintaining roads in France, exclusive of salaries of inspectors, amounts to 80 cents per head of the population. There are three kinds of roads: First, national roads, about 23,000 miles, yearly cost of maintenance $200 per mile (exclusive of salaries). Second, state or "departmental" roads, 23,000 miles, annual cost of maintenance $160 per mile. Third, vicinal roads, maintained by the towns or corresponding committees, 363,000 miles, yearly cost of maintenance, according to quality and importance of road, from $30 to $110 per mile.—Oesterreichische Monatschrift.

The Witkowitz Iron and Steel Works (Bohemia) has purchased large iron mines in the Swedish-Lapland provinces. The ore, which will be brought to Austria by Stettin and thence in flats on the river Oder as far as Ratibor, thence by rail, will come to the works cheaper than Styrian ore, although the latter has to travel less than 200 miles and the former about 2,500 miles. The Witkowitz works are using some 400,000 tons of iron ore, of which from 30,000 to 40,000 tons are already being imported from Sweden. The yield of these Swedish ores is said to be about 69 to 70 per cent. iron.

The value of briquettes as fuel for torpedo boats has been attested by Mr. A. F. Yarrow at the New York meeting of the American Society of Naval Architects. He said that for torpedo boat fuel the briquettes used by the French government possessed great advantages. These briquettes are made from Welsh coal carefully selected and washed; and in trials of long duration there is consequently no clinkering. He went on to state that when he had difficulty in getting a trial through with Welsh coal he sent over for French briquettes, and then very often had no further difficulty.

The officials of the Cincinnati, Hamilton and Dayton Railroad are looking for a steel bridge, weighing 62,000 pounds, which was being shipped over that road to Dayton. The freight crew under Conductor Folk loaded the bridge on three flat cars and chained them together. The train was coming south. At Troy the crew and conductor noticed that the bridge was all right, but when the train reached Dayton, the bridge had disappeared from the flat cars. Nobody saw it disappear, but it was gone. It is supposed that the bridge fell off the cars at a sharp curve, says The New York Sun.

The engine columns of new United States battleships have been made of nickel steel, and, according to a recent report by Chief Engineer E. R. Freeman, U. S. N., nickel steel was preferred on account of its toughness, in spite of the fact that the tests showed high carbon steel used in similar columns to have somewhat better physical characteristics than the nickel steel. A severe cold-bending test told in favor of the nickel steel, although the elongation and reduction of area were in favor of the high carbon steel. The nickel steel columns tested were all accepted, while some of the others were not, because of defects which the annealing failed to overcome.

Three mountain railways will probably be constructed in the Mont Blanc region. One of them will be a narrow gage rack railway to the summit of Mont Anvers on the eastern side of the Mer de Glace. This line is expected to be ready for traffic in 1899. The second line will lead from Martigny (on the Rhone) over the Col des Montêts to Argentière and Chamounix. It will then be possible to reach Chamounix from Bâle within one day. Electrical traction will be used on a section of this line. The third line will be a rack railway from Les Houches to a point near the summit of Mont Blanc (about 14,000 feet). The highest altitudes reached by the other two lines are about 7,000 and 4,000 feet respectively.—Uhland's Wochenschrift.

Experiments carried on in England have proved that fine coal or slack coal is an excellent material for sewage filtration. At the Wolverhampton Sewage Works, as a result of twelve months' working, it has been observed that the efficacy of the coal had increased. Prof. Bostock Hill has recently pointed out that coal appears to have a special power of removing the putrescent organic matter from the sewage. The effluent is particularly bright, and shows a marked diminution in the quantity of oxygen absorbed. It is also perfectly free from odor, and thus gives evidence that the organic matter removed is that portion particularly which is in a state of putrescence. On examining the interior of the filter, after a constant use of many months, it has been found to be quite free from odor and to have nothing but a slight earthy smell.

ELECTRICAL NOTES.

In a recent storm at Paris the Eiffel Tower was repeatedly struck by lightning.

A telegraph line recently run to Coomassie form the coast is highly appreciated by the Ashanti natives. They cut off the wire in suitable lengths to make armlets.

An electrical contemporary states that Prof. Foerster, of Dresden, has found that by using a nickel bath of 50 deg. to 90 deg. C., instead of the usual one of 18 deg. to 20 deg., one can make layers of bright nickel of high density which will polish well.

The Sussman electric miner's lamp, recently tried with success in Belgium, consists of a small accumulator of two cells, with an incandescent lamp attached. It burns from twelve to sixteen hours and gives a light from two and one-half to five times brighter than the ordinary miner's lamp. It keeps a light in any position, and is not extinguished by a current of air or an explosion.

Some time ago attention was called to the fact that the Western Union Telegraph Company was using copper wire exclusively on new construction and renewals on its principal lines. The company has recently completed a line of copper wire from New York to San Francisco, the longest heavy copper wire for telegraphy in the world. This wire is strung between San Francisco and Ogden, along the Southern Pacific, and from Ogden to Omaha, along the Union Pacific.

The first trial trips on the electric rack railway up the Gorner Grat, near Zermatt, were recently carried out in the presence of the inspectors of the Swiss Railway Department. The section completed has a length of 1,600 meters and a gradient of 12 per cent. The tests were satisfactory, both the ascent and descent being effected without the slightest difficulty, the motors holding the locomotive perfectly to its proper speed. Starting on the maximum gradient with a fully loaded train was also effected with great facility.

For the first time in eight years there was a hanging in Honolulu. The man whose life was surrendered on the gallows was a Hawaiian named Noa. Noa's victim was a Chinese storekeeper, of the island of Molakai. There were three electric push buttons connected with the arrangement, set in a table in a distant building in the prison yard. Three prison wardens touched them when the word was given. One of the buttons opens the death trap. No man, save the electrician who put them in, knows which one that is. This is very much on the order of military executions, in which a platoon of soldiers fire at the victim, a part of the guns being loaded with blank cartridges.

Considerable progress is being made in Central and South America with water power for the generation of electricity. Coal is scarce and dear, but water is cheap and plenty, says The Mining and Scientific Press. In Mexico the Pueblo Lighting Company transmits 965 horse power 9 miles into the city; at Pachuca 3,300 horse power is sent 16 miles; the San Rafael paper mills have 750 horse power; the Mazipal Copper Company, of Concepcion del Oro, has a 400 horse power plant; an 800 horse power plant is to convey power 8 miles for the Jalapa Light Company, and San Miguel and Chihuahua are supplied in like manner. In Argentina 5,000 horse power is conveyed 16 miles to Cordova; at Lima, Peru, 150 horse power is sent 5 miles; and Escuintla (Guatemala), San Salvador (Salvador), San Cristobal (Venezuela), and San Gil (Colombia) are all supplied with electricity by water power.

Aschermann, in the Zeitschrift für Elektrochemie, describes a new method for preparing chromium in the electric furnace. A gastight steel furnace is used in connection with a movable electrode. A gastight fitting graphite crucible is placed in the furnace and in it are placed oxide of chromium and sulphide of antimony, in the proportion of 10 to 23. Chromium oxide, sulphur and antimony, 10 to 10 to 23, can also be used, but the results are not so favorable. After the furnace is closed gastight, a comparatively light current, say of 20 to 25 amperes, is passed through the material to be melted. A reaction takes place attended with the development of much heat. The resulting mass consists of a regulus of a chromium-antimony alloy, while the upper part of the crucible has an amorphous mass of antimony oxide, sulphide and traces of chromium oxide, adhering to the walls. Repeated melting of the regulus removes every trace of antimony, although it is much easier to powder and roast this regulus at white heat, when the antimony is driven off. Chromium has the property of dissolving a considerable proportion of carbon, which separates out as graphite again upon cooling. At about 3,600° F. chromium volatilizes.

Electricity as a motive power was recently called into play in drilling thousands of holes through the webs of the rails of the South Side Elevated Railroad, in Chicago, while the motive power was being changed from steam to electricity. One hole, ⅞ of an inch in diameter, was needed in each end of every rail, and altogether there were 20,000 holes to be drilled. The work had to be done while the road was in operation, and the space for operating drills was only the nine inches between the wheel rail and the heavy wooden guard rail. The work would ordinarily be done with ratchet drill stocks operated by hand, but with these progress would have been very slow. Instead of this, electric motors were called into use. Each motor was mounted in a little car which ran upon the wooden guard rails, and drove a flexible shaft ten or twelve feet in length, which in turn ran the drill. The drill for each machine was mounted in a compact frame, with a screw at the upper end, and the whole thing, drill, frame and screw, was just of a size to fit in between the metal rail and the outer wooden guard rail. In some places where there were convenient crossovers in the tracks the motor wagons could be kept in place on the guard rails and drilling could be done continuously, but at other places the work had to be done between trains, and these often ran under two minutes' headway. The outfits proved to be so handy for the purpose and the men working them became so expert that during the entire progress of the work not a train was delayed for more than ten seconds by the drillers.

SELECTED FORMULÆ.

Water Bug Exterminator.—The following compound is said to be the most satisfactory article for getting rid of water bugs, beetles, etc.:

Calcium sulphate anhydrous	1 pound.
Sodium chloride	5 ounces.

Mix. Sprinkle around holes and wainscoting.

Brass Facing Half-Tones.—To increase the wearing qualities of zinc half-tones, the Process Photogram suggests facing the half-tone with brass, and recommends the following bath formula:

Zinc carbonate	10 parts.
Copper carbonate	10 "
Sodium carbonate	20 "
Sodium bisulphite	20 "
Potassium cyanide	20 "
Arsenious acid	½ "
Water	1,000 "

To make up the solution proceed as follows: Take 12 parts sulphate of copper and 12 parts sulphate of zinc, and dissolve them in water, then add carbonate of soda, already dissolved, to the solution. This precipitates the copper and zinc in the form of carbonates, a greenish-colored powder. Allow the precipitate to settle and pour off the supernatant liquor. Wash the precipitate and then mix it with the carbonate and bisulphite of soda in 900 parts water. Next dissolve the cyanide and arsenic in the remaining 100 parts of water and pour this into the first solution. This bath should be used cold. Why brass is recommended for facing half-tones instead of steel or nickel does not appear; the latter metal particularly possesses all the advantages of brass, and the solution is more readily prepared and easier to manage. However, it is doubtful if any process for protecting half-tones by depositing metal upon them will ever become popular for the finer grade of work, because of the danger of impairing the delicacy of the original. When the half-tone is to be subjected to a long run, it is preferable to make a copy in nickel. By this method the original is preserved intact for future use.—Practical Process Worker.

Printing Names on Photographs.—The following is a very good method of printing titles or names in black upon prints: The name or other matter to be printed on the photograph is set up in type, and printed on cardboard; from this make an exposure on a transparency plate, developing it strongly. After the print has been made from the regular printing negative, it is placed under the dense transparency of the regular negative, and the name printed in. The only precaution necessary is to time the transparency negative properly, and develop strongly, so as to get good contrast. Photographers will find this a much easier and quicker method than the old one of printing on tissue paper and fastening same to the negative by means of varnish; moreover, the result is black instead of white, usually much more pleasing.

Glycerine for Hardening Steel.—It is stated by the Pharmaceutische Zeitung that soft steel placed in glycerine of 1·08 to 1·26 specific gravity, heated to from 180° to 200° C., and let remain for some time, gradually becomes hard, and that the higher the temperature of the glycerine, the harder the steel. We think that our contemporary has forgotten to state that, after remaining in the hot glycerine the stated time, the metal should be suddenly cooled off either in water or in quicksilver.

Liquid Bottle Lac.—The Zeitschrift f. d. ges. Kohlan Ind gives the following: Into a half gallon bottle put 8 ounces of shellac, and pour over it a pint and a half of alcohol of 94 degrees and 2½ ounces of sulphuric ether. Let stand, with occasional shaking, until the shellac is melted, and then add 4 ounces of thick turpentine and a half ounce of boric acid. Shake until dissolved. To color, use the anilin colors soluble in alcohol—for red, eosin; blue, phenol blue; black, negrosin; green, anilin green; violet, methyl violet, etc. If it is desired to have the lac opaque, add 8 ounces of pulverized steatite, but remember to keep the lac constantly stirred while using, as otherwise the steatite falls to the bottom.

Ink for Stylographic Pens.—In answer to the request of a correspondent The British and Colonial Druggist gives the following formula:

Indigo carmine	1 drachm.
Gum arabic, powdered	150 grains.
Tannic acid	325 "
Pyrogallic acid	10 "
Iron sulphate	220 "
Liquid carbolic acid	1 drachm.
Simple sirup	90 minims.
Distilled water	20 ounces.

Mix.

Preserving Eggs.—Marsh dissolves in each gallon of water 12 ounces of quicklime, 6 ounces of common salt, 1 drachm of soda, ½ drachm saltpeter, ½ drachm tartar and 1½ drachms of borax. The fluid is brought into a barrel and sufficient quicklime to cover the bottom is then poured in. Upon this is placed a layer of eggs, quicklime is again thrown in and so on until the barrel is filled so that the liquor stands about 10 inches deep over the last layer of eggs. The barrel is then covered with a cloth, upon which is scattered some lime.

(2) A French authority gives the following: Melt 4 ounces of clear beeswax in a porcelain dish over a gentle fire and stir in 8 ounces of olive oil. Let the solution of wax in oil cool somewhat, then dip the fresh eggs one by one into it so as to coat every part of the shell. A momentary dip is sufficient, all excess of the mixture being wiped off with a cotton cloth. The oil is absorbed in the shell, the wax hermetically closing all the pores. It is claimed that eggs thus treated and packed away in powdered charcoal in a cool place have been found after two years as fresh and palatable as when newly laid.

(3) The Cyclopedia of Receipts says that water glass or silicate of sodium has recently been used in Germany for rendering the shells of eggs non-porous. A small quantity of the clear sirupy solution is smeared over the entire surface of the shell. On drying, a thin, hard, glassy film remains, which serves as an admirable protection and substitute for wax, oils, gums, etc. —Pharmaceutical Era.

THE DREYFUS TROUBLE IN PARIS.

NOTHING since the time of the Commune has so stirred Paris, and all France too for that matter, as the trial of Count Esterhazy for betraying military secrets, his subsequent whitewashing and the attack of M. Zola, the novelist, on the army. The trouble all arose from the trial and conviction of Captain Dreyfus, an officer in the French army of the Jewish faith, who was arrested, tried and convicted for alleged high treason and sentenced to life imprisonment in a colony, for his divulging secrets concerning the army to a foreign power, traced to him. The accuser, who followed the accused closely, made a point of this admission and created a sensation by quoting from a letter in which Major Esterhazy spoke of his readiness to commit a crime for money. That, said the major, meant suicide, so that with thrust and parry and with the most direct cross swearing on the part of the minor witnesses, proceeded the case which has turned nearly all Paris into hot partisans on one side or the other. The proceedings on the next day were conducted in secret. Therefore, not much is known about it. The trial ended by the acquittal of Count Esterhazy by a unanimous vote of the only the beginning of the sensational developments which have stirred France to the core. Sometimes a nation, like an excitable individual, falls into a fit of rage almost as unreasoning and irresponsible as mild insanity. Such an attack seized France at this time, and it is impossible to tell into what excesses of prejudices and injustice it will lead her. Instead of being simply directed toward Dreyfus, France is now indulging in a bitter passion of rage and hatred against the Jews. History shows almost no counterpart of such an extraordinary effect of passion and prejudice upon men ordinarily sane and possessing a sense of honor. Here

COL. BOUGON.

COL. DE RAMEL.

LIEUT.-COL. GAUDELETTE.

LIEUT.-COL. MARCY.

CHIEF OF BATTALION M. LEGUAY.

M. RIVALS, CHIEF OF ARTILLERY.

THE DREYFUS SCANDAL—MEMBERS OF THE COUNCIL OF WAR.

Count Esterhazy was tried by court martial on January 11. His accuser was M. Mathieu Dreyfus; his sister-in-law, Madam Alfred Dreyfus, and the wife of the officer already condemned for selling France's secrets of defense to foreign powers, were in court. Major Esterhazy was charged with having written the "bordereau" which was made the basis of the Dreyfus conviction. The report of Gen. Ravary, who has inquired into the charge, was then read, and this brought out the suspicion that Col. Picquart had formed against Esterhazy. The accused man went into the witness box and asserted his innocence, admitting that the writing of the bordereau was so like his own that it might have been members of the court. After the verdict had been announced the officers comprising the court shook hands with the count and congratulated him upon having disproved the charges. The crowd cheered vehemently and cried, "Long live Esterhazy!" "Long live the Army!" "Down with the Jews!"

The verdict was almost universally approved. Most of the French people declared that his acquittal was a relief for the public conscience. All must bow before the decision of the court and consider the affair as ended. It would, perhaps, have been fortunate for France, though not probably for Dreyfus, if the matter could have ended here. The decision of the court was was a man known to be guilty of the vilest offenses known to the law and human society, is publicly known to have penned many traitorous words, yet he was acquitted of the crime for which Dreyfus was condemned. His judges and brother officers hastened to shake hands with and congratulate him and the public proclaimed him a martyr of the army. This is simply bewildering in a nation which has usually a keen sense of honor and which is so intensely patriotic. The secret may be found in anti-Semitism, which has been fermenting among the masses in large towns for years and which, sooner or later, threatened an explosion. The demonstration was not so much in favor of Count

Esterhazy as against those accused of conspiracy against him. Public passion was increased to white heat by M. Emile Zola, the novelist, who addressed an open letter to the President of the republic. This terrible philippic was directed to the army and government, and was like pouring oil upon the fire. The motives of M. Zola may or may not have been solely patriotic, but at any rate, he has succeeded in getting himself the most talked of man in the world in a few hours. The letter is one of the most scathing ever brought against a nation, and its clearcut and sweeping charges may prove very hard to refute. It is a point blank accusation that the Minister of War and all his staff have deliberately thwarted justice in order to save that department from public discredit. The following is a sample of Zola's virile pen:

"But what a splash of mud has been cast on your name, I had almost said on your reign, by this abominable Dreyfus affair! A council of war has just dared, by order, to acquit an Esterhazy, thus giving a fearful blow to all truth and justice; and it is now over France, who has pollution on her cheek, while history will write that it was under your presidency that such a social crime could be perpetrated!"

It is hardly worth while to review Zola's history of Dreyfus' condemnation, but he makes a strong case for his client and also a clear record of the court martial. He ends with the following:

"I accuse Col. Du Paty de Clam of being the devilish author of this miscarriage of justice. I accuse Gen. Mercier of being, through weakness, I suppose, an accessory to one of the greatest iniquities of the century. I accuse Gen. Billot of holding certain proofs of Capt. Dreyfus' innocence and keeping them secret, and of having committed this crime against his country, mankind and justice for a political purpose to save his staff. I accuse Gen. Boisdeffre and Gen. Gonse of being accessories to the same crime. I accuse Gen. Pellieux and Maj. Ravary of having carried on the scoundrelly inquiry in a spirit of monstrous and, as the indictment shows, of shameless partiality. I accuse three experts in handwriting of having made wrong reports, unless they are insane. I accuse their staff of carrying on in the press an abominable campaign to pervert public opinion. I accuse the first court martial of having violated the law in giving judgment on a secret document, and, second, of cloaking this fault by order and of committing the crime of willfully absolving the guilty man.

"I have only one passion, and that is for the light in the name of humanity which has suffered so much, and which is entitled to happiness. My burning protest is but the cry of my soul. Let them dare drag me into the Assize Court and let an inquiry be made in the full light of day. I await them."

The great publicity which M. Zola gave to this letter naturally forced the government to take cognizance of it, which was exactly what M. Zola wished. Students began to be riotous. On January 17 they crossed the Seine and made a serious demonstration in the center of the city, especially in the neighborhood of M. Zola's house, the windows of which were broken. Crowds marched up and down the Boulevard crying, "Down with Zola!" "Death to the Jews!" There were several sharp encounters with the police, but at last they mustered in sufficient force to break up the mob. Many arrests were made. Mass meetings were held to protest against the "Dreyfus syndicate." The communists, socialists, and anarchists were very much in evidence, they called upon all revolutionists to oppose the decisions of those who, under pretense of patriotism, were seeking to enslave the people under the rule of the sword.

The agitation began to spread into the country, and anti-Jew demonstrations were organized in many different places. The outbreaks in Marseilles were particularly serious. The shops and warehouses occupied by Hebrews were attacked. Gentile tradesmen in Marseilles hung placards outside their shops, "This is a Catholic shop," in order to avoid attack.

The position of the government became worse and worse. Finally it was announced that the trial of Zola would be held in the Seine Assize Court about February 7. Summonses were served on Zola and the manager of the newspaper in which the alleged libelous matter was published. Zola announced he had fully prepared his defense. On January 19 one of the Paris police was attacked by an anarchist and terribly injured. The affair was a direct outcome of the prevailing excitement. A disgraceful chapter was added to French history on January 22, when the anti-Semitic excitement culminated in a free fight in the Chamber of Deputies. The scene in the Chamber and, in the afternoon, the condition of Paris and the country at large was such that the French nation seemed seized with a sudden madness which it was impossible to check until it had spent its fury. The capital had not been in such a state of nervous excitement since the days of the Commune.

THE DREYFUS SCANDAL—COUNT ESTERHAZY.

The government announced they would base their prosecution only on certain passages in the letter. M. Zola renewed the serious charges which had been ignored in the government indictment. It certainly was a foolish proceeding on the part of the authorities to attempt to arraign M. Zola for a few expressions in his famous letter while ignoring his charge impugning the honor of the chief officers of the army. Zola's reply was so contemptuous and bitter that it inflamed both sides of the Chamber and the populace. The dilemma of the government has now become serious. It will stultify itself if it fails to prosecute Zola on a side issue, refusing him the right to present proof of his principal charges. This is becoming evident to everybody and serves to create a degree of exasperation which found some vent in the disgraceful events in the Chamber on January 22, which it is only too probable will lead to the overthrow of the Meline government.

The next day large detachments of soldiers and police held the commanding points of the city, giving, with the excited groups moving about and attempting demonstrations, a revolutionary aspect to the town. Grave riots occurred the same day in Algiers, at which conflicts took place between the anti-Semites and the Jews. Three Frenchmen were killed, thirty Jews were wounded and a number of shops occupied by Hebrews were pillaged and the looted goods were burned. The mob in Algiers, on January 24, was only dispersed with the greatest difficulty, as it numbered 3,000 persons.

Harold Frederic, special correspondent for The New York Times, cabled on January 22 that he had spent a week in Paris watching the streets, attending the meetings of the discontented and talking with many friends in public life. He says that on the whole his experience confirms his earlier impression, that the Dreyfus agitation is more an effect, or rather a symbol, than a cause. Indeed, within the week ending on the 22d, the question of the Dreyfus case itself had visibly receded to the background, and the question of public order and the stability of the government had pushed itself to the front.

M. Zola's courage has shamed scores into stepping forth, who had already understood the merits of the case. Mr. Frederic says:

"So far as Dreyfus himself is involved, my impression is that he will eventually be liberated, unless, indeed, his jailers take the advice of the Paris mob, and kill him before slow justice gets to him. In sober truth, I could find nobody of intelligence and education who really believed him guilty. Those whose business it was to force their lips to defend his conviction permitted their eyes to explain their inner reservation. This struck more than anything else among what are called the educated classes in Paris. There is apparently only one opinion, namely, that a mistake was made.

"I think, further, that nine out of every ten of this class would have been glad if, when the question was raised four months ago, the government had seized the opportunity of repairing this error in candid fashion. For various reasons the Ministry decided not to do this, but to defend the indefensible. This raised the question whether it was worth while for the sake of one man, whom nobody in the army had ever liked personally, and who, though wrongfully convicted, was still, in blood, a German Jew, to discredit a French Ministry, affront the army's principal generals and perhaps precipitate anarchy on the country. This was the reasoning which kept the bulk of Frenchmen of the better class on the anti-Dreyfus side till only the other day. It is Zola's vehement appeals, harangues and reproaches which are bringing them over now, and which are compelling both radicals and socialists in the Chamber to trim their sails for the new wind. In the face of this changing opinion it is not going to be possible for any Ministry to keep an innocent man in chains indefinitely."

He says the Jews of Paris were not frightened and that the army will find Zola bitterly accusing on the trial on February 7. Speaking of the generals' feeling for Zola, he says: "Their rage at him is something awful in its intensity, and it will be strange if they will be restrained by paper bonds of legality from striking at him." Our engravings represent the officers who tried Count Esterhazy and a portrait of Count Esterhazy, for which we are indebted to L'Illustration.

CHINA OF TO-DAY.

TALK about the partition of China, in the common and natural sense of those words, continues to go on in some quarters that ought really to be better informed, for it is the veriest moonshine. What is China? A population equal to that of combined Europe distributed rather compactly, for the most part, in villages ruled by immemorial custom, administered each by its own ancients serving without compensation, designated by common consent without any formality of choice. Their authority is grounded in the personal respect that character commands; they are not always the oldest nor always the ablest, but are those who command confidence through elevation of character and rectitude of life. They have nothing to do with imperial administration, which is a wholly separate affair. That touches the people at but few points of daily life, much as the federal government of the United States touches the people at but few. This huge mass of self-governing humanity is composed of individuals whose leading characteristics are that they are laborious, frugal and cheerful, practicing hospitality and the primitive virtues. This is not the view of China presented by the missionaries as the pretext for their own existence, but it is the truth.

The imperial government is a thing apart. Centuries have elapsed since the literary class succeeded in persuading the people to accept literary examinations as the qualifications for public office. They next inculcated systematically the doctrine of peace at any price and a contempt for the soldier and for the military career. This propaganda may have been superfluous; a career that led to nothing must have fallen, unaided by doctrine, into sufficient contempt. Having thus erected themselves into a governing order and possessed themselves of a monopoly of administration, the inevitable result followed that they came to use it for personal enrichment alone. They forestalled the subversive instincts of those gifted with natural abilities by holding the door open to admission into the literary career; they thus secured the adhesion of those who might otherwise have been tempted successfully to assail their rule. Their sole interest thenceforward was to maintain the existing state of things and their own monopoly of power, and this has been the posture of affairs during several centuries, but by no means for so many as is often assumed. The village rule, on the other hand, has subsisted immemorially and is incapable of change.

This literary order is the "China" known to diplomacy, much as though the institute of notaries, let us say, or the collective body of journalists or of stock brokers might conceivably come to represent the "France" known to diplomacy. So long as such a body should maintain itself as the government de facto, other nations could have no concern with the agricultural or industrial or trading portions of the French people, or, in other words, with nineteen-twentieths of the population. And in the example supposed, just as actually in China, the members of the ruling order would confine themselves to exacting contributions from the mass and pocketing them. This is the principle that governs Spanish administration, for example, and is to-day practiced in France by methods of indirection, and hence its existence in China in all of its purity and bald simplicity is entirely intelligible when we bear in mind the length of time it has had in which to establish itself.

Imperial administration in China, then, is merely confined to the exaction of imposts and malversation

of the proceeds. But in general this is accomplished by trade imposts along the great lines of water communication, and so is rarely felt by those who pay them. Occasional "squeezes," as they are called, or forced loans, fall only upon the wealthy, who are able to stand them, and leave the great masses of the people untouched. The Chinese are passionate and able traders; the trading class is naturally found mainly in the cities which lie upon the rivers; the population is so huge that the aggregate volume of trade is very great. Hence there need be no surprise that trading fortunes are built up rivaling any that are known to the West. It is in these that the viceroy or subordinate "mandarin" dips from time to time by means of his squeeze. Now, all that the western world wants—at least for the present—is to supplant these literary leeches, not for the purpose of duplicating their tactics, but for that of securing the free movement of goods through replacing their arbitrary exactions by a moderate and uniform toll.

This is the system which England long since forced upon China to secure the entry of goods into the Treaty Ports, and put a man of her own, Sir Robert Hart, at the head of the customs service she organized and the terms of whose import duties she dictated. But this arrangement has still left the goods subject to exactions from the inland magistrates (likin), and this "loot" it is now the purpose of the Powers to abolish. It will be observed that their object will have been completely attained as soon as they shall have extended to the interior of China the principle of the Hart system imposed by England at the Treaty Ports. In undertaking to root out the confessed evil they are establishing spheres of influence, Russia undertaking Mongolia and Manchuria, France the provinces south of Canton, and Germany those reached by the northern Gulf. This still leaves English influence paramount in respect of the general entry of goods at the mouths of existing channels of trade, and deprives her plaints of any just foundation.—New York Sun.

ARCHÆOLOGICAL DISCOVERIES IN NORTHERN AFRICA.

NORTHERN Africa has always been a fascinating country to archæologists. France is there carrying on with energy the great work of retrospective exploration that has been so fertile in results for the last fifteen years. French Africa has now several fine museums that might be envied by many cities of France, and among which may be mentioned that of Bardo, near Tunis, that of Saint Louis, at Carthage, and the one at Algiers inaugurated in 1896 upon a hill of Mustapha. Accident sometimes seconds the efforts of scientists. During the demolition of the Arabic and Turkish fortifications at Algiers, there were discovered the débris of the Roman rampart of Icosium, and, on the other side of the gulf at Cape Matifou, numerous funereal steles and votive objects derived from ancient Rusgunia. At Castiglione there is a Christian basilica in which has been found an interesting crypt and some baptismal fonts in the shape of a cross. At Cherchell, M. Wallio is still carrying on the series of excavations that he has been making for several years. Here there have been found a number of statues and some portraits of the last kings of Mauritania. At Collo, Captain Helo has explored a Punic necropolis of the second and third centuries before our era. At Setif, Lieutenant-Colonel De la Comble has disengaged the ruins of a Roman villa and a small cemetery surrounded with walls, in the center of which stands an edifice composed of several chambers with mosaic pavements. Finally, Timgad continues to emerge from the earth, district by district. The service of historic monuments has here cleared away the region in the vicinity of the capital.

Tunis is year by year revealing to us a little more of its past. Archæology has now thrown some light even upon the old indigenous civilizations. M. Hamy has studied the Berber necropolises of Enfida, and especially Henchir-el-Hassel, the largest one. The tombs consist of cylindrical bases that support steps in the form of a low cone surmounted by a large slab. M. Leroy has recognized the existence of analogous monuments in the open desert to the southwest of Biskra, on the Wed Djedi side. M. Novak has explored the Phenician necropolis of Mahedia. Through a rectangular well provided with a stairway, a descent is made into the tombs, each of which comprises one or two vaults wherein the bodies were laid out upon the floor or upon benches or else deposited in graves. The Roman ruins of Tunis often afford our explorers agreeable surprises. Here, for some time past, there have been met with works of a fine industrial art, if not of art properly so called. At Soussa, upon the site of a rich villa of the first century of our era, Captain Dupont has discovered quite a collection of handsome mosaics. At the entrance there are flowers and fruits and fishing scenes; upon a wall of the hallway, a marine landscape; in the dining room, a true painting representing the Rape [of Ganymede; and, all around, medallions in which figure birds, quadrupeds and fishes. In one of the wings there is a large fresco representing the Triumph of Bacchus.

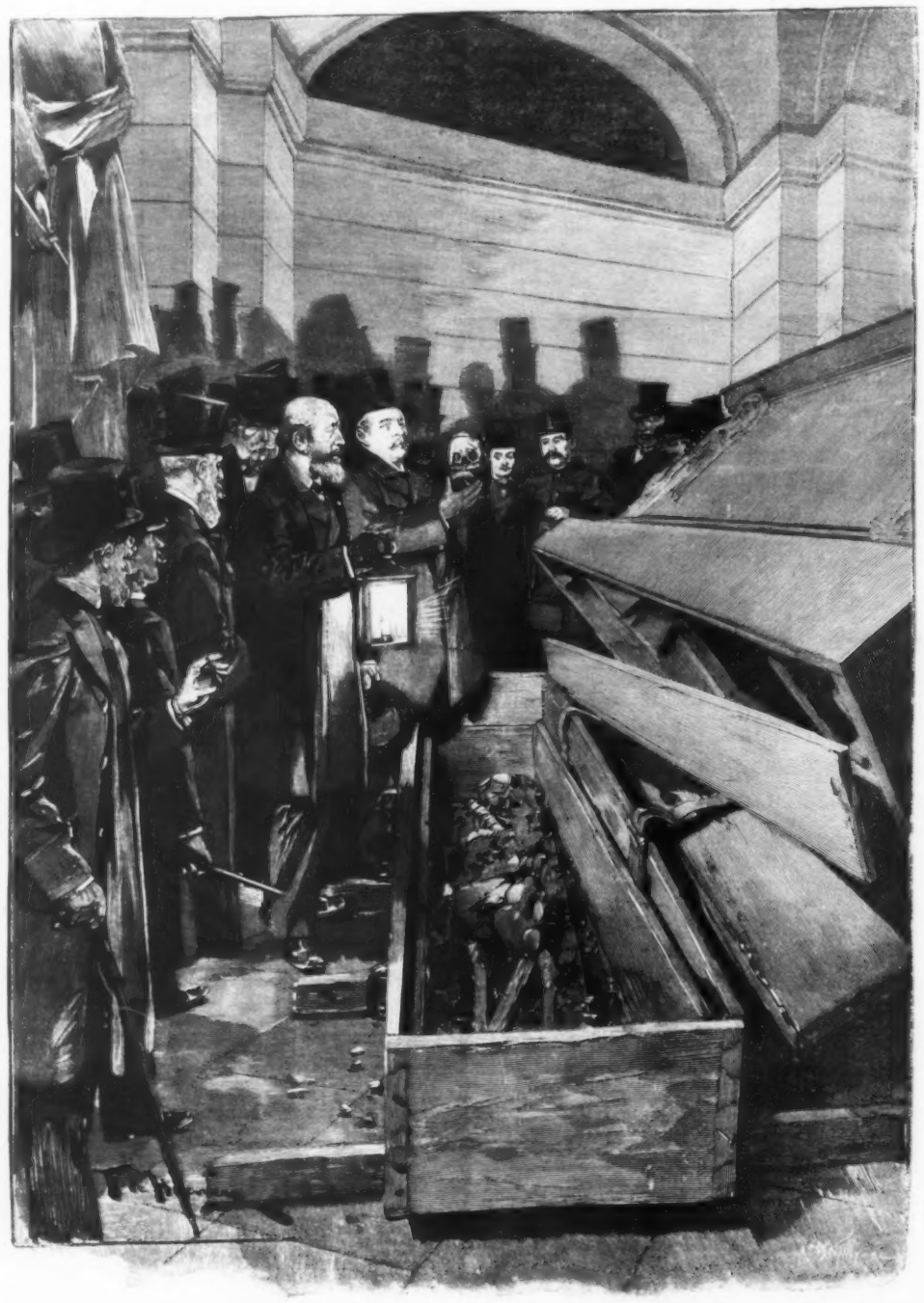
But the most valuable finds of this kind are those made at Oudna. Here M. Ganckler has unearthed several houses, especially a vast villa of the first century of our era—the villa of the Laberii, decorated with exceptional magnificence. There are here nearly a hundred figure mosaics, many of which have been carried to the Bardo museum. The collection embraces an extraordinary variety of subjects, such as mythological scenes, representations of divinities, figures of animals and plants, farm buildings, scenes of domestic life, and of fishing, hunting, etc. Nowhere else can we so well appreciate what the art of mosaics was in Roman Africa. During the work of dredging in the port of Bizerte there were fished up numerous antique objects derived from shipwrecked vessels, and especially a magnificent patera with reliefs of very delicate workmanship representing different mythological scenes.

To the Christian epoch belong several interesting monuments which have been studied. At Sicca Veneria (Le Kef) the service of Tunisian antiquities has uncovered the basilica of Saint Peter, which appears to date back to the beginning of the fifth century. At Hadjeb-el-Aioun, to the southwest of Kairouan, there has been unearthed another and very richly decorated basilica. The atrium of this had a mosaic pavement, and the walls of the nave, of the apsis, and of the vestries were ornamented with paintings or covered with tiles of terra cotta. These various African civilizations are met with at Carthage. Not so long ago it was stated that the very ruins of the latter have perished. This is not entirely true. The labors of archæologists have decided against the skepticism of the poets. Although the ground of Carthage has been explored for a long time, it seems to be inexhaustible. Father Delattre, whose domain this is, has gradually revealed the history of the great city. In recent years he has examined the different Punic necropolises in succession, and has completed his researches in the sepultures of Saint Louis and Bordj-Djedid. He has opened 800 tombs in the district of Douimes alone. The same arrangement is found almost everywhere: chambers formed in the sandstone closed by one or more slabs, and into which a descent is made through a well several feet in depth; in each chamber two graves, in each grave two bodies. There are everywhere lamps, pottery, rude vases of diverse forms, plates, and sometimes objects that show Egyptian or Phenician influence. To the west of the city, Father Delattre and M. Ganckler have explored a new cemetery of the employés of the imperial administration. Here and there have been collected mosaics and a few Roman marbles, and among others, a statue of Empress Julia Domna as a muse. Under the hill of Saint Louis there has been discovered an old subterranean chapel, which is reached by a stairway. The walls of this crypt bear traces of frescoes and of numerous Christian monograms, carved by old pilgrims. It was doubtless an old dungeon, consecrated by the sufferings of martyrs. Finally, Father Delattre has attacked the amphitheater, of which he has already cleared away the arena. This structure is not in such a state of ruin as has been supposed. It has nearly the dimensions of the Coliseum. The excavations promise to be fertile in results. There have already been found many coins and pieces of pottery, objects of all kinds, and a series of curious inscriptions upon sheets of lead. What remains of this celebrated amphitheater, made illustrious by so much heroism, will soon be rendered up to us.—Revue Encyclopédique.

OPENING OF THE SARCOPHAGI OF VOLTAIRE AND ROUSSEAU.

THE researches which, according to a previous announcement, were to be made with a view to the identification of the remains of Jean Jacques Rousseau and Voltaire took place at the Pantheon on Saturday, December 18. As well known, a special committee, with Senator Hamel as its president, had been appointed to this effect by M. Rambaud, Minister of Public Instruction.

As too often happens, the administration had made no provision or preparation for the occasion. The necessary laborers had not been engaged, and, moreover, puerile questions of precedence were raised. It was then that the assemblage showed its discontent, and protested against the negligence shown. Fortunately, M. Ernest Hamel, who is a man of coolness and energy, arranged matters and calmed the storm, and, after a delay of half an hour, Voltaire's sarcophagus, which was of wood painted and decorated with inscriptions, was raised. It was found to cover a rectangular beech-wood box 6½ feet in length by 20 inches in width.



OPENING OF THE SARCOPHAGUS OF VOLTAIRE.

This box rested upon three cross pieces of wood placed simply upon the floor. Upon the upper edges were found the remains of seals made of red wax. Fleurs-de-lis were still distinguishable, but the seals had disappeared. The box was closed by two iron straps.

M. Hamel found that it was really the box described in the minutes of the removal and replacing of the remains in 1821 and 1830. A laborer removed the iron straps with a chisel and detached the top board. There was then perceived a rotten wooden coffin closed by two thin rusty iron straps, but, as the latter were partially broken, the laborer had no trouble in removing the lid. The bones of Voltaire then came to view, and were found to be in a disintegrated state. M. Georges Berger, deputy of the Seine, took the skull of the great writer from the hands of M. Berthelot and raised it above the spectators. Every one was struck with the resemblance of it to the well known image of the great man, especially to the admirable marble by Houdon that stands in the foyer of the Comedie Française. There was a moment of deep emotion; we were present at a genuine resurrection.

At this moment M. Hamel exclaimed: "Gentlemen,

we are really in the presence of the remains of Voltaire; of that there is no possible doubt. The Restoration has been accused of profaning them, but that is an accusation which falls in the presence of facts, as I am happy to state."

The same operations took place in the vault that contained the sarcophagus of Jean Jacques Rousseau. This sarcophagus, which was of wood and plaster, was raised like that of Voltaire. It was found to contain a large rectangular leaden box placed upon a trestle with six legs. Upon this box were engraved the following words:

HIC JACENT OSSA JOHANNI JACOBI ROUSSEAU.

CI-GIT ROUSSEAU.

ANNO 1778.

When this box was opened a wooden coffin appeared, and then a second coffin of lead. It was indeed the triple funeral casing in which Marquis Rene de Girardin had the body of the philosopher (whose friend he was) deposited. After the laborers had made an opening in the last coffin, we saw the skeleton of Jean Jacques Rousseau in an admirable state of preservation. The arms were crossed upon the breast and the head was slightly inclined to the left. A light fabric covered the mortal remains and was the material of the shroud, which had not entirely decayed. Those present were again touched in reflecting that here was all that remained of the great thinker who had filled the world with his glory. Mr. Berthelot took in his hands the skull, which, like that of Voltaire, had been sawed in two for the autopsy, and found that there was no perforation in it, no trace of a ball and no fracture. This discovery disposes of the legend according to which Rousseau put an end to his life by a pistol shot.

Let us hope that the marble tombs asked for and obtained by M. Hamel from the tribune of the Senate for Voltaire and Jean Jacques Rousseau will soon be forthcoming.

For the above particulars and for the engravings, which were made from photographs taken by flash light, we are indebted to L'Illustration.

OPENING OF THE SARCOPHAGUS OF JEAN JACQUES ROUSSEAU.

A DROWNED CONTINENT.

By R. LYDEKKER, B.A., F.R.S.

As many of our readers are doubtless aware, deep boring operations are being undertaken in the island of Funafuti, in the Ellice group of Polynesia, with the primary object of ascertaining the depth to which coral rock or limestone of coral origin extends. If it were found that such coral-made material extended to depths far below the level at which living coral can exist, there would be evidence that the island on which the experiment was conducted had subsided. And if subsidence were thus proved to have taken place in a single island selected almost at random, the conclusion could hardly be resisted that the greater part, if not the whole, of Polynesia must likewise be a subsiding area, or, in other words, the remnants of a drowned continent, some of the higher lands of which are indicated by the atolls and other islands of the Coral Sea. It is, therefore, a favorable opportunity for a few words in regard to the permanence or otherwise of the great oceanic basins and continental areas of the globe. This subject, it need scarcely be said, has not only an intense and absorbing interest of its own—for it is difficult for anyone except a geologist to fully realize that the solid ground on which he stands may have been buried fathoms deep beneath the water—but is also one of the utmost importance in regard to many puzzling problems connected with the present and past geographical distribution of terrestrial animals and plants on the surface of the globe.

Although it might well have been thought that opinion in matters scientific would be unlikely to veer suddenly round, and after tending strongly in one direction incline with equal force in the one immediately opposite, yet there are few instances where the swing of the pendulum of opinion to one side has been more sharply followed by its oscillation to the other than has been the case in the problem of the permanency of continents and oceans. When geology first began to take rank among the exact sciences, and it was demonstrated that most of the shells and other fossils found in the solid rock of many of our continents and islands were of marine origin, it was a natural, if hasty, conclusion that land and sea had been perpetually changing places, and that what is now the center of a continent might comparatively recently have been an ocean abyss. Accordingly, when any difficulty in finding an adequate explanation in regard to the geographical distribution of the animals or plants of two or more continents or islands occurred, the aid of an "Atlantis" or "Lemuria" was at once invoked without misgiving, and a path thus indicated across which the inhabitants of one isolated area could easily have passed to another.

This was one swing of the pendulum. But as methods of geological observation and investigation became more exact and critical, it was soon obvious that, in many areas at least, the alternations between sea and land could not have been so frequent or so general as had been at first supposed. It was, indeed, perfectly true that many portions of some of our present continents had for long periods been submerged, or had been at intervals alternately land and sea. But at the same time, it began to be realized that the fossiliferous marine deposits commonly met with on continents and large islands were not of such a nature that they could have been laid down in depths at all comparable to those now existing in certain parts of the basin of the Atlantic. Even a formation like our English chalk, which had been supposed to have analogies with the modern Atlantic deposits, appears to have been laid down in a sea of much less depth and extent, and probably more nearly comparable with the modern Mediterranean. Then, again, it was found that large tracts in some of our present continents, such as Africa and India, had existed as dry land throughout a very considerable portion of geological time. Moreover, it was asserted that no formations exactly comparable to those now in course of deposition in the ocean abysses could be detected in any of our existing continents or islands; while it was further urged that in none of the so-called oceanic islands (that is, those rising from great depths at long distances from the continental areas) were there either fossiliferous or metamorphic rocks, similar to those of the continents and larger continental islands.

This was the second swing of the pendulum, and for a long period it was confidently asserted that where continents now exist there had never been any excessive depth of ocean; and, conversely, that in the areas now occupied by the great ocean abysses there had never been land during any of the later geological epochs. It was, indeed, practically affirmed that wherever the sounding line indicates a thousand fathoms or more of water, there sea had been practically always, and that no part of the present continents had ever been submerged to anything like that depth.

Almost as soon as the pendulum of opinion had attained the full limits of its swing in this direction (and this swing had been largely due to the influence of geologists and physicists), there began to be signs of its return to a less extreme position. It was, in the first place, proved that a few deposits—and these of comparatively recent date—analogous to those of the ocean abysses, do occur in certain areas. And, in the second place, it was shown that a few oceanic islands do contain rocks like those of the continents, and are not solely of volcanic or organic origin. Zoological and paleontological discoveries were at the same time making rapid advances; and the students of these branches of science, who had been among the foremost in giving the swing of the pendulum on the side of continental instability its first impulse, now began to press their views—only in a more moderate manner—in the same direction. Evidence had long been accumulating as to the [illegible]ity of certain freshwater formations and their [illegible]ed animal and plant remains occurring in [illegible]erica, South Africa, India and Australia; [illegible] urged that during the secondary period of [illegible] history not only was Africa connected with [illegible] way of Madagascar and the Seychelles, but [illegible] extended across what is now the South Atlantic to connect the cape with South America, and that probably India was likewise joined to Australia by way of the Malay Archipelago and Islands. In fact, there seems good evidence to indicate that at this early epoch there was a land girdle in comparatively low latitudes encircling some three-fourths of the earth's circumference from Peru to New Zealand and Fiji.

Even taking into account the comparatively early date of its existence, this girdle of land, the evidence in favor of which can scarcely be shaken, gave a heavy blow to the adherents of the absolute permanency of continents and oceans, as it clearly indicates the comparatively modern origin of the basin of the South Atlantic. But this is not all. South America, which there is good evidence to believe was long cut off from the northern half of the New World, shows certain indications of affinity in its fauna with that of Europe in early Tertiary times, and to a certain extent with that of modern Africa; and the only satisfactory way of explaining these relationships is by assuming either the persistence of the land connection between the Cape and South America across the South Atlantic till a comparatively late geological epoch, or that such connection took place further south by means of the Antarctic continent. There are several objections, which need not be considered here, in regard to the latter alternative; and since there is other evidence in favor of the comparatively recent origin of the South Atlantic depression, the persistence of a land connection in lower latitudes seems the more probable explanation.

In addition to all this, there is evidence of a more or less intimate relationship between the land faunas of Australasia and South America; and as similar types are not met with in Africa, and several of them belong to groups unlikely to have endured Antarctic cold, it has been suggested that America and Australasia were in connection at no very remote epoch by way of the Coral Sea. It is known, for instance, that some of the Australian marsupials are more or less closely allied to others which inhabited South America before it was connected with North America; and as no kindred types are met with either in the latter area, in Europe, or in Africa, a land connection by way of the South Pacific, and that at a comparatively recent epoch, offers almost the only satisfactory explanation of the means of transit, if the Antarctic theory be rejected. And it may be mentioned in passing that the acceptance of even the latter would imply a large modification from the existing distribution of land and water in the southern hemisphere.

But the evidence for a land connection by way of the Pacific does not by any means rest on the testimony of marsupials alone. Passing over certain groups, it may be mentioned that the earthworms of Australia and New Zealand are strangely like those of Patagonia, and have no very near relatives in Africa; while an almost equally strong affinity is stated to exist between the Patagonian and Polynesian land slugs. Neither of these groups of animals are fitted to withstand the cold of high latitudes, and it is difficult to see how the members of the second, at any rate, could have reached the two areas by any other means than a direct land connection.

Turning now to the brief reports hitherto received as to the results of the Funafuti boring, it appears that this has been carried far below the limits of coral life, and is still in coral limestone. So far, therefore, the advocates of the theory that Polynesia is the remains of a sunken continent have scored a great triumph; and although there is still the possibility that some of the atolls in this vast area may prove to be perched on the denuded summits of extinct submarine volcanoes, even this would not interfere with the general conclusion. If deeper borings should result in touching rocks more or less similar to ordinary continental sedimentary deposits or metamorphic crystallines, an even firmer basis would be afforded to the hypothesis of subsidence which has now received such striking confirmation.

As the result of the boring it appears, then, that there is a possibility that the community between the South American and Australasian faunas may admit of being explained by means of a direct land connection between the two areas at a comparatively recent geological date. Even, however, if this explanation receive future support and acceptation, there are, as in all similar cases, still many difficulties with which to contend. One of these is the practical absence of all non-volant mammals from Polynesia, with the exception of the Solomon group, where a few cuscuses and rats are found. But the case of the West Indies—where there is every probability that there was formerly a large mammalian fauna, the majority of which were drowned by submergence—may very likely afford the solution of the difficulty. Worms and slugs would probably find means of survival in circumstances where mammalian life would disappear. This explanation will, however, clearly not apply in the case of New Zealand, where, if mammals had ever existed, their remains would almost certainly have been discovered. It must be assumed then that, if Polynesia was the route by which the faunas of Australia and Patagonia were formerly connected, New Zealand was at that time isolated. And, indeed, seeing that the hypothetical land connection between the areas in question must have existed at a comparatively late epoch, it is most likely that the ancient Polynesian land was already broken up to a considerable extent into islands and archipelagoes, so that the main line of connection may have been but narrow, and from time to time interrupted. Indeed, it must almost of necessity have been but incomplete and of short duration after the introduction of modern forms of life, as otherwise the types common to Australia and Patagonia would be much more numerous than we find to be the case. Hence there is no improbability in the suggested isolation of New Zealand during the period in question.

But, putting these interesting speculations aside, the results of the Funafuti boring indicate almost without doubt that Polynesia is an area of comparatively recent subsidence; and it has already been mentioned that there are good reasons for regarding a large part of the basin of the South Atlantic as of no great antiquity, while the area of the Indian Ocean appears to have been considerably enlarged during the later geological epochs. Apparently, therefore, the great extent of ocean at present characteristic of the southern hemisphere is a relatively modern feature.

Hence it is clear that the extreme views prevalent a few years ago as to the absolute permanency of the

existing continental and oceanic areas clearly stand in need of some degree of modification. And what we have now to avoid is that the pendulum should not once more take too long a swing in the opposite direction.

So far as the great continental masses of the northern hemisphere are concerned, it would appear that portions of these have always existed to a greater or lesser extent as land. But the great extent and homogeneous character of formations like the Mountain Limestone, the Chalk, and the Nummulitic Limestone suggest that sea was much more prevalent in this area than it is at present, and that, so far as the Old World is concerned, the continental area has been growing. The North Atlantic, and probably also the North Pacific, may apparently be regarded as basins of great antiquity. On the other hand, in the southern hemisphere, although Africa, parts of Australia, and at least some portions of South America, are evidently land surfaces of great antiquity, they, together with the islands of the Coral Sea, seem to be mere remnants of a much more extensive southern continent or continents. Conversely the southern oceans have gained in area by swallowing up these long lost lands. Obviously, then, although true in a degree, continental permanency has by no means been the only factor in the evolution of the present surface of the globe.—Knowledge.

In the Plaza de Toros, of Madrid, a combat was recently fought between the famous man eater tiger Cezar and the bull Regatero, says The New York Times. The bull was the first to appear in the inclosure. He was walking leisurely when the tiger glided in and at once sprang upon him, firmly implanting his claws in his hide. The bull, taken by surprise, seemed at first undecided what to do; then with a terrible bellow he reared up and shook his adversary off. He backed several paces, and charged, taking the tiger upon his horns and throwing him ten feet into the air. He then retired and repeated the attack. He did this again and again, and each time the tiger, after being thrown, would land on his feet. After the tenth trial, Cezar seemed to lose heart; he retired to a corner of the arena and pretended to be dead. The bull could not get at him there, but kept careful watch, and each time the tiger moved, Regatero lowered his head to charge. At length the tiger stole out, but was immediately charged by the bull, which had moved several yards away. Regatero, this time, sure of his prey, gored without throwing. The tiger rolled over apparently dead, but, when the door to his den was opened, he made a dash for it. The bull, following, gave him a few parting strokes of the horn. During the entire combat the audience showed the greatest enthusiasm, and applauded wildly the attacks of the bull, while they hissed the strategic movements of the tiger.

THE STANDARD BREEDS OF GEESE.*

THE description of the standard breeds of geese prepared by Mr. George E. Howard, secretary of the National Poultry Association, and published by authority of Dr. D. E. Salmon, the Chief of the Bureau of Animal Industry, in No. 64 of the Farmers' Bulletin of the United States Department of Agriculture, completes the series of interesting papers issued which have been so welcome to every farmer in the country and to the large class of amateur breeders which are to be found in every State in the Union. Interesting illustrated articles on chickens and ducks will be found in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 1023 and 1151 respectively.

The standard breeds of geese are seven in number, and are as follows: The Gray Toulouse, White Embden, Brown Chinese, Gray African, White Chinese, Gray Wild and Colored Egyptian.

The Gray Toulouse geese (Fig. 1) are named after the city in France of that name, where they are extensively bred. In this country they are numerous and are fairly well thought of for market purposes, although their flesh is too coarse and flabby to be highly prized for the table. They are termed Christmas geese, as they are late in maturing and just about right at holiday time.

The Toulouse goose has a gray colored plumage of different shades, becoming white on the belly. The head, neck and back is of dark gray, the tail feathers are gray and white and the ends tipped with white.

The bird is compact in shape, with a large and short head with a short bill. The body is broad and slightly curved and it almost touches the ground. The eyes are dark brown or hazel in color. Their bills, shanks, toes and webs are of deep reddish orange color. The standard weight of the adult is 20 pounds.

White Embden geese (Fig. 2) originally came from Embden, in Westphalia, and are considered a very practical bird for farming and pay well. They are nice looking, tall and erect, and have a snow white plumage. They are not prolific layers, producing about 20 eggs in the season, which is only half the average number laid by the Toulouse goose.

They have fine square bodies, rather large heads and medium sized bills; long necks which are carried upright. The eyes are bright blue, bills flesh colored, shanks, toes and webs a deep orange. The average weight of the adult gander is 20 pounds and the goose 18 pounds.

The Gray African goose (Fig. 3) is considered by many breeders the most profitable of all geese to raise. They grow the heaviest in the shortest space of time, and are ready for market in ten weeks, weighing at that age 10 pounds. They are very much like the Pekin duck in this respect, and as compared with other geese give the most satisfactory results for the least labor and time spent in growing them.

Their flesh is fine for table purposes and they are first class layers, and average over 40 eggs during the season.

These geese have a large head, with a large knob and a heavy dewlap under the throat. These and the Chinese geese are different from all others in the head, and are the only two breeds having a knob on the head. The bill of the African is rather long and stout at the base and their necks long, their backs long and flat, breasts moderately round and full, and large, long, upright bodies. The wings large and well folded against the body. The knob is black and the dewlaps of a gray color. The plumage is of various shades of gray, darkest on the back and lighter under the body.

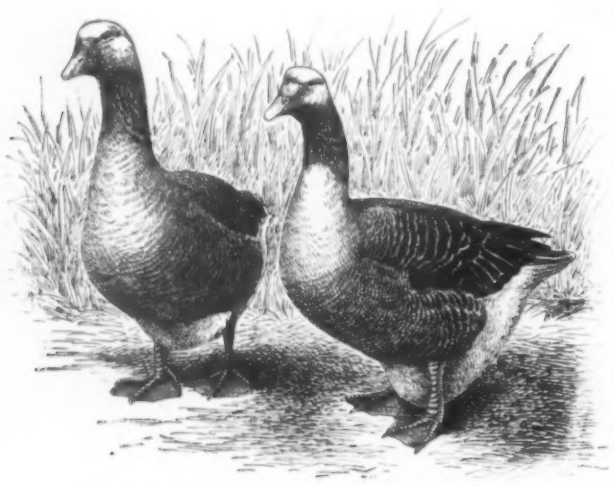


FIG. 1.—PAIR OF GRAY TOULOUSE GEESE.

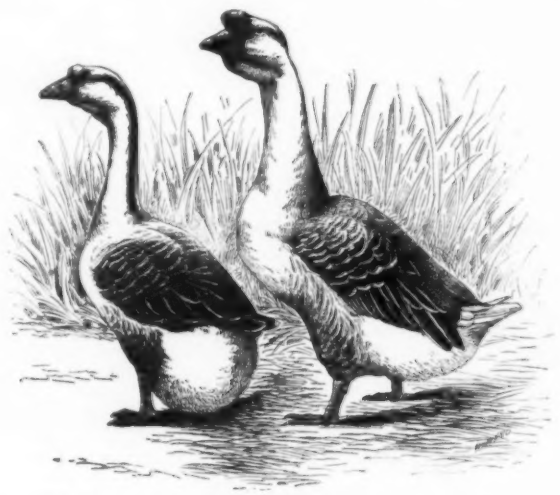


FIG. 3.—PAIR OF GRAY AFRICAN GEESE.

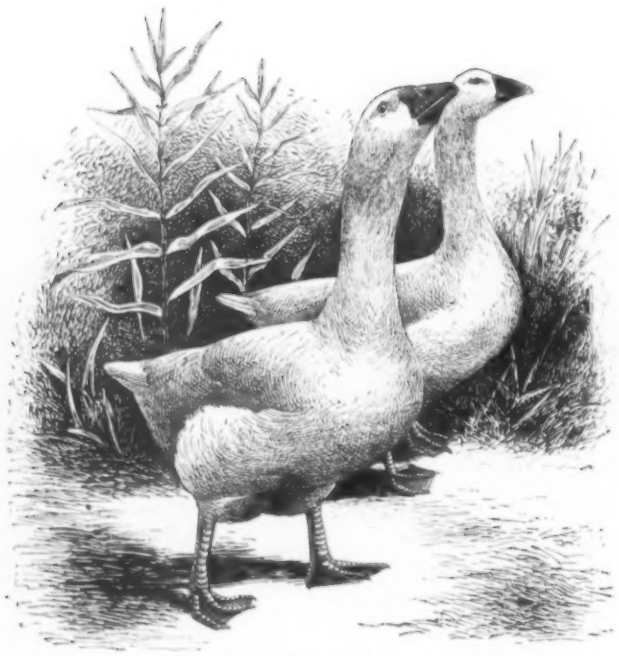


FIG. 2.—PAIR OF WHITE EMBDEN GEESE.

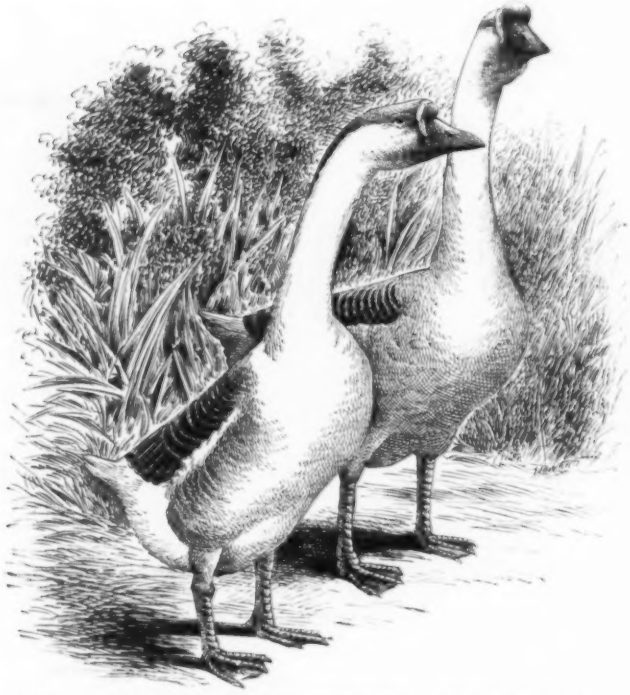


FIG. 4.—PAIR OF BROWN CHINESE GEESE (YOUNG).

The eyes are hazel or brown, bill black, and the toes and shanks a dark orange color.

Brown and white Chinese geese are the smallest of the breeds of geese and weigh from 6 to 7 pounds lighter than those previously described. Their want of size has no doubt prevented them from becoming favorites, but what they lack in size they gain in egg production, being the most prolific of all breeds of geese, averaging from 50 to 60 eggs a year, while in size, aptitude to fatten and ease of management they appear in no respects inferior to other geese, while the quality of their flesh is decidedly superior. They are exceedingly graceful in appearance, quite hardy and mature early. There are two varieties of Chinese geese, the brown and the white; they have large heads with a large knob at the base of a medium sized bill, and large, gracefully arched necks.

The backs are medium in length, and the breast round and full, wings large and strong, thighs short and stout.

The color of the Brown Chinese geese is brown, knob dark brown or black, neck light brown or grayish brown, with a dark stripe from the head down to the body. The plumage is a dark brown on the back, lighter on the breast and under parts. The eyes a dark hazel or black, and the shanks, toes and web a dusky orange color.

The color of the White Chinese geese is a pure white

* Abridged by Prof. John Michels, late U. S. Department of Agriculture.

throughout, perfectly free from feathers of any other color. The knob and bill of orange color, as are also the shanks, toes and webs. The eyes are a deep leaden blue. The average weight of the gander is 14 pounds.

Gray Wild geese (Fig. 5) are among the best known of domestic geese, and are very generally bred throughout the entire country, and are the most valuable and practical birds for goose raising, as they are highly prized for table purposes, besides being good layers, hardy and easy to rear.

These geese have a rather small head, small bill, sharp at the point, large slender neck, snaky in appearance. The back is long and rather narrow, and is

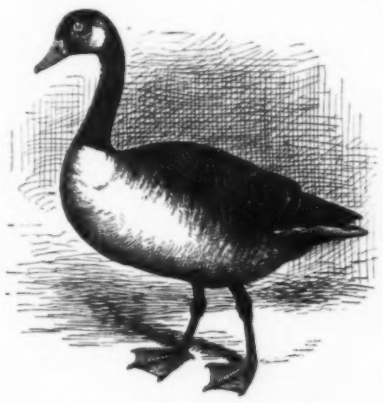


FIG. 5.—GRAY WILD GOOSE.

arched from neck to tail, breast full and deep, and body long and somewhat slender. The wings are long, large and powerful, and the thighs are rather short. The head of the wild goose is black, with a white stripe, and nearly covering the side of the face. Bill and neck black and back dark gray. The breast is a light gray, which grows lighter as it approaches the legs. The plumage of the under parts of the body from the legs to the tail is white. The tail feathers are glossy black

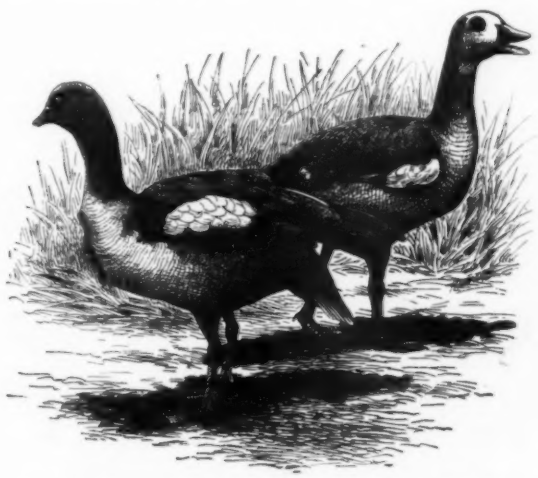


FIG. 6.—PAIR OF COLORED EGYPTIAN GEESE.

and the thighs are gray, the shanks, toes and webs are black. The eyes are also black. The standard weight of the adult gander is 16 pounds.

The most beautiful of the breeds of geese are the Colored Egyptian, but they are purely ornamental, not having been bred in this country for any other purpose than the show room. They are sometimes called the Nile goose. This goose is tall and slender, which gives it an elegant appearance, not possessed by any other breed.

It can be bred in confinement, but is of a very quar-

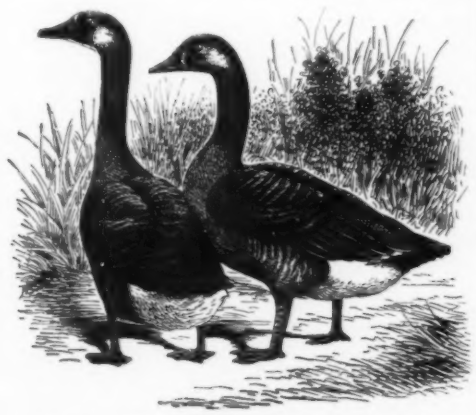


FIG. 7.—WILD AND AFRICAN CROSS.

relsome disposition, and the male will fight to the death other males of the same species. The males must each be given a separate pen and mated with the females.

The color of the head is black and gray. The bill purple or bluish red and the eyes orange. The neck and back are gray and black, the center of the breast chestnut and the remainder is gray. The upper parts of the plumage of the body are gray and black and the under parts are a pale yellow, penciled with black. The shoulders of the wings are white, with a narrow black stripe or bar. The tail feathers are glossy black, thighs pale buff. The shanks, toes and webs, reddish color.

The standard weight of the adult gander is 15 pounds.

CROSS BREEDING.

The most satisfactory results are to be had from

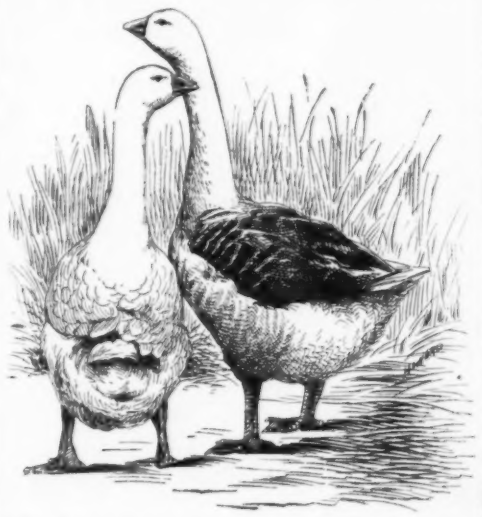


FIG. 8.—EMBDEN AND TOULOUSE CROSS.

breeding pure standard bred stock without crossing. But to those who are partial to crosses the following are considered the best to make :

No. 1. Wild gander on African goose.
No. 2. Embden gander on Toulouse goose.
No. 3. Emden gander on African goose.

The crosses will give good growths and the young birds will dress well for market. Crosses should only be made for market purposes, and should always be bred from original stocks.

In conclusion it may be said that all breeds of geese, except perhaps the Egyptian, are to be recommended to farmers who keep a limited number, in addition to other poultry, and allow them the freedom of the farm, but when goose raising is to be more extensively engaged in, the African is to be especially commended. It is the quickest to mature, most prolific and the easiest to handle of any of the varieties.

RAINDROPS: THEIR SIZE AND RATE OF FALL.

IN the course of a detailed study of the phenomena of waterspouts, Prof. F. H. Bigelow suggests the desirability of further statistics as to the actual size of

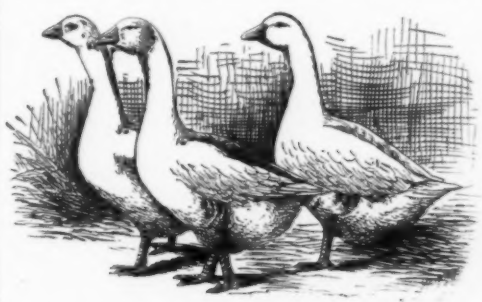


FIG. 9.—EMBDEN AND AFRICAN CROSS.

large drops of rain. This is a matter that suggests a series of beautiful laboratory experiments, and we hope that it will be taken up by some of the many physicists who are seeking to apply their skill and the resources of their laboratories to the problems whose solution will give precision to meteorology.

It is evident that the size of the drops must depend upon the surface tension of the water relative to the air or other gas through which the drops are falling; it must, therefore, vary with the purity and temperature of the water and the electrification of the drops. Experiments should include the salt water of the ocean. As drops falling from a tube or other metal surface depend for their size upon the capillary action between the water and that surface, it would be better to avoid that method of formation of drops and to imitate the rain either by allowing a mass of water to fall through a sieve or by studying the drops formed near the summit of a vertical jet of water at a point where the falling steam breaks into drops. The best memoir upon this subject known to the editor is one published by J. Wiesner at Vienna in 1895. No copy of this memoir is at hand, but an excellent review is given in the Meteorologische Zeitschrift, July, 1896. In general, Wiesner concludes that the largest drops that fall in tropical rains, and, therefore, anywhere throughout the world, weigh less than 0·26 gramme. This result was arrived at by three different methods, but in all three the water was allowed to drop from some solid support, such as the end of a tube or the lower surface of a cloth filter. However large the drops may be at their origin, they soon break up, so that after falling 5 meters their weight does not exceed 0·20 gramme, and measurements made during the heaviest natural rains give the maximum rain drop 0·16 gramme, while by far the largest number were between 0·06 and 0·08 gramme. If drops are ever found larger than these, they can only hold together when falling with velocities much less than would be attained by falling 5 meters. Drops are said to have been observed of one inch in diameter. These must have weighed 7·14 grammes and could only have existed for an instant before breaking up. The suggestion that they are simply melted hailstones does not account for their formation, since it would require a considerable time for such large hailstones to melt. They might have been formed by the agglomeration of large drops held up by a momentary rising gust of wind, but could not have held together after that gust had ceased.

Experiments made at Vienna on the velocity of falling drops show that during a fall of 20 meters there is no sensible increase in the velocity; so that drops weighing from 0·01 to 0·25 gramme, falling through distances of from 5·5 to 22·2 meters, fall with uniform and approximately the same velocity of somewhat more than 7 meters per second. Special experiments were made to ascertain how far such drops must fall in order to attain this uniform constant speed. The method of determining this distance consisted in examining the characteristics of the blotches made by the falling drops on striking white blotting paper. A maximum velocity is apparently attained by a fall of a few meters, as shown in the second column of the following table, the weight of the drop being given in the first column :

Weight of drop.	Falling distance.	Eventual maximum velocity.
Gramme.	Meters.	
0·01	1 to 2	7 meters per second in all cases.
0·03	2 to 3	
0·06	2 to 4	
0·07	3 to 5	
0·10	5 to 8	
0·16	8 to 11	
0·20	9 to 14	

It is probable that the acceleration of drops falling from a great altitude does not become zero until the drop has fallen much more than 22 meters. It is also probable that the increasing velocity does not attain a maximum before reaching the earth.

If the latter be true, it seems to the editor likely that it results from the fact that the drop is perpetually changing its shape, ever adapting itself to the increasing velocity, so that it preserves continuously the shape of a body of swiftest descent for a given velocity and resistance. The resistance is made up of three factors, viz.: The inertia of the disturbed air and the viscosity, or internal friction, of the air and, also, of the drop. As the drop passes from the cloud to the earth the inertia resistance increases with the steadily increasing density of the air; the viscous resistance to the air increases with the increasing temperature; the viscous resistance to motions within the interior of the drop diminishes with increasing temperature. Finally, the size of the drop diminishes steadily by evaporation, viz., diffusion, even if the speed does not attain such a limit that the internal motions of the drops break it up into fragments.

These several considerations make it probable *à priori* that the drop eventually falls with uniform velocity, and this conclusion is confirmed by the observation made by Mach, that the apparent line of descent, when a gentle, uniform wind is blowing, is approximately a straight line.—Monthly Weather Review.

ASTRONOMICAL PHOTOGRAPHY WITH PHOTO-MICROGRAPHIC APPARATUS.*

By A. CLIFFORD MERCER, M.D.

ON October 20, 1892, occurred a partial eclipse of the sun, and my heliostat was placed on a shelf outside a south window. Within the room was a portrait lens of 81 inches focus and a microscope in the small axial line. The substage condenser was removed, and a camera connected with the eye end of the microscope tube. Such sunlight as fell on the mirror of the heliostat was reflected through the portrait lens. The portrait lens projected an image of the clouded sun's disk about $1\frac{1}{10}$ inches in diameter, in the plane usually occupied by an object on the stage of the microscope. The tiny image was itself projected by a microscope objective of $1\frac{1}{2}$ inches focus to form a second image, $2\frac{3}{5}$ inches in diameter, on the ground glass of the camera. The clouds made sharp focusing impossible. Only an imperfect focus was obtained. The clock of the heliostat kept the image steadily on the ground glass.

During the eclipse sensitized plates were substituted for the ground glass. Exposures were made when the clouds were thin enough to permit. Thus six negatives

* Transactions of the American Microscopical Society.

were secured. The first print shows the moon's black disk, advancing apparently from the northeast across the sun's disk, while the second shows the moon's disk passing off to the west.

This is the first record of an attempt to use photo-micrography astronomically. All of the necessary apparatus could be easily packed in a trunk. If an unaided telescope objective were used to project an image of the size obtained, a focus of 21 feet would be required, and the lens would have a diameter of about 16 inches. Such an objective, properly mounted, would result in an instrument nearly half as large as the great Lick telescope, with its photographic objective. By using a portrait lens having a focus of 15 inches or 16 inches, a size commonly used for cabinets in photographers' studios, instead of the portrait lens, the apparatus will produce a negative image equal in size to that produced by the unaided Lick lens; or, leaving the portrait lens in place, the same result could be obtained by substituting for the microscope objective of 1½ inches focus another of about double the power, one of ¾ inch focus. The Lick instrument has a tube about 50 feet long and 42 inches in diameter, while this apparatus has 2 tubes less than 1 foot long and about 1 inch to 6 inches in diameter respectively. To the smaller tube is attached a camera with a bellows extending from 1 foot to 6 feet. Stability and freedom from vibration are very easily obtained with the small and short apparatus. The difference in cost is enormous.

In several respects the photo-micrographic arrangement has advantages over the great Lick photographic instrument.

If, however, we turn to matters of light and separating power, the very great superiority of the Lick objective is seen. The results given in the following tabular comparison are only approximately accurate. The loss light suffers by absorption as it passes through glass and by reflection at incident surfaces is not taken into account, the Lick objective consisting of three thick lenses, and the photo-micrographic arrangement having more than twice as many, but comparatively very thin, lenses and the mirror's reflecting surface.

	Lick Objective.	Larger Portrait Lens.	Smaller Portrait Lens.
Diameter of objective..	33 in.	3·75 in.	2 in.
Focus of objective.....	550 in.	15 in.	8 in.
Focus divided by diameter....	16·66	4	4
Relative value of light in first image.....	1	16	16
Size of first image.....	5·1 in.	0·1395 in.	0·0744 in.
Total equivalent focus 550 in., divided by diameter	16·66	147	275
Relative value of light in final image.....	1	$\frac{1}{77}$	$\frac{1}{317}$
Time of exposure, eclipse of sun (about)...	$\frac{1}{1000}$ sec.	$\frac{1}{70}$ sec.	$\frac{1}{300}$ sec.
Separating power.. ...	1	$\frac{1}{8·8}$	$\frac{1}{16·66}$

Other things being equal, separating power varies with the aperture or diameter of the objective. If the Lick objective, having an aperture of 33 inches, could barely show a certain double star as two distinct stars, it would be impossible for any objective having an aperture of 4 inches or 2 inches to show such a double star as two distinct stars. A star apparently single when seen through any objective having an aperture of 2 inches might be seen to consist of sixteen or seventeen stars in line, almost touching one another when seen through the Lick photographic objective. A star apparently single when seen through any objective having an aperture of 33¾ inches might be seen to consist of eight or nine stars in line, almost touching one another, when seen through the Lick photographic objective. The power of resolving an apparent single star into two or more, or of showing the details of sun spots or other objects, is known as separating power. A superior correction of aberrations is now possible in lenses made of small disks of glass, which are produced in great variety as to optical properties, a variety not yet realized in large disks.

PYRAMID GEOMETRY.

By Major D. W. LOCKWOOD, U. S. Engineers' Office.

THE treatment of the circle in modern geometry is based on the algebraical statement that $\pi D = C$, D being a diameter and C a circumference corresponding to it. If the circumference of a circle is equal to its diameter multiplied by π, then is the reverse true, to wit, the diameter of a circle is equal to its circumference divided by π, or $\frac{C}{\pi} = D$; in other words, there is a diameter corresponding to any length of line regarded as the circumference of a circle.

Fig. 1.—Let A B C be an isosceles triangle, the angles at A and C being equal, call the angle at the base $\varepsilon\imath$, represent by b the base A C, and let h represent the height B D of the triangle, perpendicular to A C. Then the relation between A C and B D may be expressed as follows: $\frac{2b}{h} = X$ or $h = \frac{2b}{X}$. We also have $h = \frac{b}{2}$ tang $\varepsilon\imath$.

Equating these values, there results $X = 4$ cotang $\varepsilon\imath$. Draw A E and C E perpendicular to A B and B C respectively. The angle D A E equals $90° - \varepsilon\imath$, hence $D E = \frac{b}{2}$ cotang $\varepsilon\imath$ or $\frac{b}{8} X$.

The foregoing expressions being general, X may have any value as π, in which case the angle at the base of A B C becomes $\varepsilon\imath'$, and there results $\pi = 4$ cotang $\varepsilon\imath'$ and $D E = \frac{b}{8}\pi$ or one-eighth of the circumference of a circle of which A C = b is the diameter. When $\frac{2AC}{BD} = \pi$ the area of the triangle $ABC = \pi \frac{BD^2}{4}$ since area $ABC = \frac{1}{2}(AC \times BD)$ and $AC = \frac{\pi BD}{2}$.

The area of triangle A C E = ½ (A C . D E) or

$$\tfrac{1}{2}\left(AC \cdot \frac{AC}{8}\pi\right) = \tfrac{1}{4}\pi\left(\frac{AC}{2}\right)^2$$

or one-fourth the area of the circle of which A C is the diameter.

In the following discussion a perfect pyramid is assumed to be a right pyramid with a square base, so proportioned that the angle at the base is such that its cotangent equals π divided by 4, or in which the relation between the height and base side is the same as

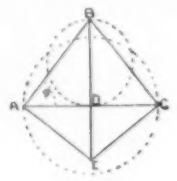


FIG. 1.

that which exists between a radius and arc of 90° of its circle.

THE RELATION BETWEEN THE CUBE AND SPHERE.

In a sphere whose radius is R, the diameter of the circle cut out by a plane parallel to and 30° from an equatorial section is equal to $R\sqrt{3}$. This is also the long diagonal of a cube whose edge is R, so that if a second sphere be constructed whose diameter equals the diameter of the circle of 30° of the first sphere, it will circumscribe the cube of the radius of the first sphere. The areas of the great circles of these two spheres will be to each other as 4 to 3, and the volumes of the spheres as 8 to $3\sqrt{3}$.

Fig. 2.—In the figure, let I K L P be the face of a cube whose edge P L equals R. With Q, the middle point of the base, as a center, and Q C equal to P L equal to R, as a radius, describe a circle. Lay off O Q equal to $\frac{R}{2}$ and draw B C parallel to P L.

Then the line B C equals $R\sqrt{3}$. On B C construct the isosceles triangle A B C. Then calling the angle at the

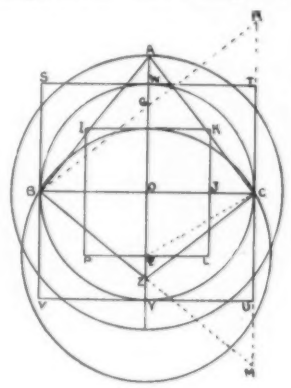


FIG. 2.

base $\varepsilon\imath$ we shall have $X = 4$ cotang $\varepsilon\imath$, when

$$X = \frac{2BC}{AO}, \text{ or } AO = \frac{2BC}{X} \text{ or } \frac{2R\sqrt{3}}{X}.$$

Draw B Z and C Z perpendicular to A D and A C respectively. Then since the angle O B Z is the complement of A B O, the tangent of the former equals the cotangent $\varepsilon\imath$, and $OZ = \frac{R\sqrt{3}}{2}$ cotang $\varepsilon\imath$ or $\frac{R\sqrt{3}}{8} X$.

Construct the large square S T U V on B C as middle line, its area is $3R^2$. There are now two pyramids having a common base equal to $3R^2$; the height of the erect one being $AO = \frac{2R\sqrt{3}}{X} = \frac{R\sqrt{3}}{2}$ tang $\varepsilon\imath$. The inverted pyramid has a height O Z equal to

$$\frac{R\sqrt{3}}{2} \text{cotang } \varepsilon\imath = \frac{R\sqrt{3}}{8} X.$$

In the triangle A B Z right-angled at B, we have $\overline{BO}^2 = AO \cdot OZ$ or $\frac{3R^2}{4} = \frac{R\sqrt{3}}{8} X \cdot \frac{2R\sqrt{3}}{X}$ or we may write

$$R^2 = \frac{4}{3}\frac{R\sqrt{3}}{8} X \cdot \frac{2R\sqrt{3}}{X}.$$

Multiply both members of the equation by R^2, and the resulting expression may be put in the form

$$R^6 = \frac{4}{3} R^2 \cdot \frac{R\sqrt{3}}{8} X \cdot R^2 \cdot \frac{2R\sqrt{3}}{X} \text{ in which } R^2 \cdot \frac{R\sqrt{3}}{8} X$$

equals the volume of the inverted pyramid and $R^2 \cdot \frac{2R\sqrt{3}}{X}$ equals that of the erect pyramid. Putting the above equation in the form of a proportion, we may write

(1) $\frac{4}{3}\left(R^2 \cdot \frac{R\sqrt{3}}{8} X\right) : R^3 :: R^3 : R^2 \cdot \frac{2R\sqrt{3}}{X}$ or translated:

A cube is a mean proportional between $\frac{4}{3}$ the volume of the inverted pyramid and that of the erect, the pyramid base side being equal to the diagonal of the cube, or the pyramid base being a square equal in area to three times the base of the cube.

If in proportion (1) we make $X = \pi$, then the first term becomes equal to one-third the volume of the sphere whose diameter is $R\sqrt{3}$, the fourth term becomes the volume of a perfect pyramid, and the relation between the cube, sphere and perfect pyramid may be written as follows:

(2) $\frac{\sqrt{3}}{6}\pi R^3 : R^3 :: R^3 : \frac{2\sqrt{3}}{\pi} R^3$, or translated:

A cube is a mean proportional between one-third the volume of the sphere circumscribing it and a perfect pyramid whose base side equals the diameter of the circumscribing sphere.

It will be noted that the relations between the two pyramids, the erect and inverted, are primarily such as usually obtain between solids of this character, and that the spherical relation is introduced when the erect becomes a perfect pyramid, or the height of the inverted pyramid becomes equal to one-eighth of the circle inscribed in the common base, in which case the volume of the inverted pyramid becomes equal to one-fourth the volume of the sphere whose diameter is the length of the base side, or of the sphere inscribed in a cube of which the common base of the two pyramids is a face.

The last proportion (2) may be put in the form

$$\frac{\sqrt{3}}{8}\left(\frac{4}{3}\pi R^3\right) : R^3 :: R^3 : \frac{2\sqrt{3}}{\pi} R^3,$$

and this gives the relation between the volume of the sphere, $\frac{4}{3}\pi R^3$, whose radius is R, the cube of its radius, and a perfect pyramid constructed on the thirtieth parallel of the sphere. The volume of the sphere whose diameter is $R\sqrt{3}$ is $\frac{1}{2}\pi R^3\sqrt{3}$; substituting for π its value 4 cotang $\varepsilon\imath'$ this becomes $2R^3\sqrt{3}$ cotang $\varepsilon\imath'$ or R^2. $2R\sqrt{3}$ cotang $\varepsilon\imath'$. In Fig. 2, draw B R perpendicular to AC and R M perpendicular to BC, then O G equals O Z and B C = C M = $R\sqrt{3}$ cotang $\varepsilon\imath$ and R M = $2R\sqrt{3}$ cotang $\varepsilon\imath$. When A B O becomes $\varepsilon\imath'$ or O Z becomes equal to $\frac{R}{8}\pi$, R M becomes equal to $2R\sqrt{3}$ cotang $\varepsilon\imath'$ or $\pi\frac{R\sqrt{3}}{2}$. The volume of a sphere is equal to that of a rectangular prism whose base is the face of the inscribed cube, and whose height is equal to the diameter of the sphere multiplied by twice the cotangent of the angle at the base of the perfect pyramid, or the semi-circumference of a great circle.

The volume of the sphere whose diameter is BC will be equal to that of a rectangular prism whose base is $\frac{2}{3}$ IKLP, equal to BC divided by 3, and the height MR when angle OBZ, equal to GBO, $= 90° - \varepsilon\imath$ or ABO = $\varepsilon\imath'$, the cotangent of $\varepsilon\imath'$ being equal to $\frac{\pi}{4}$, etc.

INDUSTRIAL NOTES.

TERNE Tin Plate.—It is surprising what erroneous ideas are entertained by the general public, and by many in trade, for that matter, concerning the true meaning of certain terms in common use. A striking example of this is the word "terne" as applied to tin plate. It is usually understood that this word is derived from the French one meaning "dull." This is totally incorrect. Terne plate is a sheet or plate of iron covered with an alloy of tin and lead in the proportion of two-thirds lead and one-third tin. It is this union of the three metals, iron, lead and tin, that gave rise to the name terne plate, terne being the equivalent of the English word tern, meaning "threefold." The origin of the erroneous definition of this term was the fact that, because of the large percentage of lead used in coating terne plate, it is duller in hue than the ordinary tin plate, which is frequently designated as "bright plate" in contradistinction to the former.

Japanese Fans.—As far back as we can go in our knowledge of the country, Japan has been the most celebrated place for the manufacture of fans of all descriptions, and at the present day produces annually a greater number of these articles than all the other countries of the world put together. In the construction and decoration of paper fans the Japanese are remarkably skillful; and the low price at which a really durable article, tastefully decorated, can be obtained in Japan is astonishing to the European or American visitor. For two cents of our money a well finished and artistically ornamented fan can be procured in any city of the empire.

It will not be out of place to give some slight idea of the mode of manufacturing these marvelously cheap articles. In Japan, the bamboo is very extensively used in the construction of objects of utility and beauty; and, as might be expected, it enters largely into the fabrication of fans, for which its straight grained, elastic, and tough nature peculiarly fits it. The sticks are made from carefully cut, thin splints of bamboo by a great number of families, who work in their private houses. The leaves are of different descriptions of native paper, or of paper covered with silk tissue, decorated with block-printed or hand-printed designs.

After the leaves are cut to the required shape, the first process is to fold them accurately into the requisite number of radiating divisions. This is done by placing the leaves between oiled papers, creased into perfect form, folding them together, and subjecting them to pressure for some length of time.

After they have taken the set, they are removed from the oiled paper moulds, folded tightly and placed under heavy weights until required for fur-

ther operations. Two of the folded pieces that are to form a fan leaf are taken, and one is laid face downward upon a piece of wood and well pasted. The sticks are then laid accurately upon the pasted surface so that each one occupies the center of each alternate radiating division, and with a brush the artisan pastes the woodwork which is to be covered with the remaining piece of paper. The latter he now applies accurately, crease against crease, and after firmly pressing the entire surface so that it may adhere to the pasted paper, he folds the fan up again, pressing it to see that it takes the proper form. After several foldings and unfoldings, and sundry pressings where there may be imperfect contact between the papers, the fan so far completed is set aside to dry. The finishing processes consist in trimming the outer edge, applying the outside pieces, or "panaches," and riveting the whole together at the handle. The panaches are sometimes most tastefully decorated with incrusted and inlaid work and with carving or lacquer; but in the cheaper fans they are either of plain bamboo or are finished with lacquer of different colors.

Generally speaking, the Japanese fan leaves are not so elaborately or richly decorated as those of the Chinese or other nations. For the most part, they are covered with some simple and graphically delineated figure subject or with birds and flowers. The common fans have usually contrasts of color dashed across them, with the moon, the sun, a bird, or a flower, cleverly represented. Landscapes, sometimes expressive of the seasons, are to be seen on both wood and paper fans, painted with considerable force and delicacy.

Origin of the Names of Fabrics.—About the year 1329, the woolen trade of England became located at Worsted, about fifteen miles from Norwich, and it was at this place that the manufacture of the twisted double thread of woolen, afterward called worsted, was first made, if not invented. Linsey-wolsey was first made at Linsey, and was for a long time a very popular fabric. Kerseymere takes its name from the village of Kersey and the mere close by it, in the county of Suffolk. We have to thank Gaza, in Palestine, the gates of which Samson carried away, for gaze or gauze. Gaza means "treasure;" and precious to the fair is the tissue which covers without concealing their charms. Voltaire, wishing to describe some intellectual but perhaps dressy woman, said, "She is an eagle in a cage of gauze." Muslin owes its name to Mossoul, a fortified town in Turkey in Asia. Tulle obtains its name from that of a city in the south of France. Travelers by rail in Brittany often glide past Guingamp without remembering that it was here that was first produced that useful fabric gingham. Damask derives its name from the city of Damascus; calico from Calicut, a town in India formerly celebrated for its cotton cloth, and where also calico was printed; cambric, from Cambray, a town in Flanders where it was first made; and tweed from a fabric worn by fishermen upon the river Tweed.

Though modern lace bears many titles, and, from the names of the varieties, seems to come from many countries, yet Belgium chiefly monopolizes the industry, and the town of Ypres gives the greatest annual yield. It is there that what is called "Valenciennes" is exclusively made, and 25,000 men are employed at an industry which returns a million of money annually to the country. Valenciennes is supposed to be so called from the town, which now no longer produces it. On the other hand, "baptiste" bears the name of its original inventor, Baptiste Cambrai, who lived and worked at his loom more than five centuries ago. The texture which he constructed differed greatly from the present fabric, and, by a curious coincidence, it is Valenciennes that chiefly supplies the world with baptiste.

The Bast Industry.—The preparation of the inner bark or bast of the lime or linden tree for matting and other purposes forms an important branch of Russian industry, more especially in the governments of Wiotka, Kostroma, Kasan, and Nischni-Novogorod. A large amount is exported to England and Germany, and some of the inland uses to which the material is put is the manufacture of grain sacks, box covers, wagon covers, carpets, sieves, sails for canal boats, and shoes.

In May and June, when the flow of sap facilitates the separation of the bark, the peasants repair, with their wives and children, to the forests to obtain the material. The lower part of the bark is generally prepared for roofing purposes, being heated and pressed into the form of plates. The bark of the upper stem and the branches is bound in bundles and put in water, where it is left till September. Then it is dried by heat, divided into thin bands, and woven into mats of various strengths, weighing from two to six pounds. The strongest of these are sold in Nischni-Novogorod at about $24 a hundred. The yearly production of mats is estimated at 14,000,000, representing value of $1,600,000. Adding other articles made of linden bark, we have a sum of $2,400,000. For this, no fewer than 1,000,000 linden trees are hewn annually—a fact rather unpromising for Russian forests.

The Flower Industry of the Scilly Islands.—The inhabitants of the Scilly Islands have had many occupations. At one time they lived as wreckers and at another period they sold early potatoes at a great profit. When this latter trade was killed by the competition of the Channel Islands, they betook themselves to the flower industry. For the last ten or fifteen years the cultivation of flowers, chiefly narcissi, has ousted almost every other occupation in the five islands. In St. Mary's alone, nearly a quarter of the cultivated area of the island is devoted to flower growing. In the month of February of last year 322 tons of flowers were exported from this one island. About 200 boxes go to the ton, and each box contains from three to twelve spikes of flowers.

In St. Mary's there are about twenty-five glass houses, which vary in size from 210 by 20 feet downward. The forcing is generally over early in March, when the outdoor crop of flowers is sufficiently large for export purposes. As soon as the forcing of the narcissi is over, the houses are filled with tomato plants, and for months there is a continuous supply of this popular fruit. One of the most curious experiments in the way of forcing houses is that of a movable glass structure, about 40 feet long by 12 feet wide, on rails and with a heating apparatus attached to it. This house is moved from one end of the field to the other and the beds are so arranged as to fit the house. Two or three weeks in one position force a very large percentage of narcissi into flower, and after the flowers are cut, the house is easily shifted to another bed, and so on.

To such an extent has the cultivation of the narcissus monopolized the attention of the islanders that nearly all of the vegetables now consumed in Scilly have to be imported from the mainland. It is estimated that the islanders, despite the high cost of transportation, now make $50,000 per annum as profit from the flowers; moreover, the trade has more than quadrupled during the last five years.

HOW TO PREVENT TYPHOID FEVER IN RURAL DISTRICTS.*

By HARVEY B. BASHORE, M.D., West Fairview, Pa.

TYPHOID fever is the plague of the country districts. In a certain locality in Michigan where accurate statistics were kept it was found that in an area in which the people used well water there were just twenty-six times as many cases in proportion as there were in a city district all of whose inhabitants used a Lake Superior water. In Pennsylvania I think that the average is fully as high, at least it would reach ten to fifteen times more for the country than for the citiesre-

There is no longer a question that the prevwith the this rural typhoid arises from the fact tha the principal tion depends upon polluted well wated as spokesmn wells are infected from privies wbding to the Suor another have held typhoid excrets mother and the surrounding ground water. low and the

Wells might not be so bac productionot for the fact that the ground water inf typhoid purifies very slowly.

To eliminate this dise ain that we have to eliminate one or the ans of infection, either the well or the privy which have poisoned the waters.

It will be a hard and thankless task to get people to give up their privy vaults and use earth closets, and it will be a matter of many years' teaching before they do it.

On the other hand, changing the water supply is comparatively easy, and meets with more general approval. A good many of the small villages are already working in this direction by attempting to procure a public supply from some neighboring spring, and by this means they hope to meet the difficulty; but a public supply, such as is generally furnished to small towns, very often becomes polluted, and the danger is worse than ever. Then, too, a public supply is comparatively costly.

There is another way, however, to bridge the difficulty successfully and cheaply, and that is by substituting cisterns for the old wells. By this means typhoid fever may be eliminated more quickly and more thoroughly from rural districts than by any other method.

The problem of using cistern water has been carefully studied, and we are able to tell just exactly the size of the cistern, the amount of collecting surface, etc., necessary for any given family, calculated for the known rainfall of the district. For example, if the roof surface contains one thousand square feet and if the rainfall is thirty-seven inches, about twenty thousand gallons will be collectible annually, which at ten gallons a head daily is more than sufficient for the wants of an ordinary family. For a yearly yield of this amount the cistern need not be excessively large, for the rain does not all come down at once. A cistern five feet deep and ten feet in diameter will hold about two thousand gallons. This will probably last more than a month, and before it is exhausted there will likely be more rain to add to the supply, for it is rare that a month passes without some precipitation.

If we rely on the cistern to eliminate typhoid fever, we must pay some attention to its construction, for only on its ability to keep out soil water rests the superiority of the cistern over the well. If carefully made of bricks and thoroughly cemented, it will be proof in most cases against this contamination from the soil. I know personally of such a cistern which was made twenty-five years ago and is still as good as ever.

Cistern water generally has a peculiar flavor arising from the decomposition of vegetable materials which get into the water from the collecting surface. This may be avoided in a great measure by keeping the cistern clean and by a "cutoff," so arranged that the first washings from the roof are turned into the street; or, if thought necessary, the water may be filtered.

In order to filter cistern water all we have to do is to build a partition in the cistern, with several holes at the bottom, connecting the two sides. Into the one side is placed the filter, consisting simply of three or four feet of coarse sand or of layers of gravel, polarite and sand. Into this side the roof leader empties and into the other dips the pump. By this means cistern water may be made as palatable as any other water, and obtained at much less expense.

That the use of cistern water will prevent typhoid fever in rural districts is not hypothetical, but a fact proved by experience. In a certain county in Pennsylvania, on account of an underlying limestone formation, there is a great inability to get good well water, and as a consequence the greater part of the community uses cisterns. In this region a careful study of the records of the resident physicians has been made, and it was found that there was a marked absence of typhoid fever. One of the towns in this place, well known to the author, will serve as an example of all the rest. This town of twenty-two hundred inhabitants has for many years depended almost exclusively on cistern water, and as a result typhoid fever is practically an unknown disease. In the last twenty years, so the oldest resident physician tells me, there has not occurred one case of typhoid fever among those exclusively using cistern water. In all this time, moreover, there have been very few cases of fever in the whole town, and every one has been traced to the use of well or spring water. The exact record for the last five years is three cases of fever, which the attending physician would not call "true" typhoid. Taking these cases, however, to be typhoid, and counting one death for every twenty sick, it would make the death rate of this community something like one per ten thousand—probably the lowest, at least one of the lowest, typhoid death rates ever attained.

Here, then, is a town where the typhoid sick rate is hardly worth considering and where the death rate is almost nil.

If all rural dwellers would give up their wells and resort to the cistern, the story of this one town would be repeated everywhere and rural typhoid would become an unknown disease.

* Read by title at the Philadelphia meeting of the American Public Health Association and published in the Medical Record.

SOME QUESTIONS OFTEN ASKED ABOUT DRINKING WATER, AND THEIR ANSWERS.*

By B. C. LOVELAND, M.D., Clifton Springs, N. Y.

IN the routine of a doctor's life a great portion of his time is taken up in answering questions, and sometimes it requires much patience and the exercise of the greatest tact and ingenuity to give answers which will either satisfy the patient's curiosity or convince him of the wisdom of the order that may be the subject of his inquiries. In the present day, when the practice of medicine has become so far removed from the old time practice of "physic," and the physician has to depend on his knowledge of physiological law, and the thoroughness with which he enforces obedience to physiological law among his patients marks his degree of success, the questions elicited by the regulations he may impose may be of great importance, for the patient to-day is a rare one who will go ahead and unquestioningly obey the advice of the physician, and who will not, like the proverbial boy, always have his mouth set for "Why?" In trying to induce my patients to drink the amount of water, nine or ten glasses a day, regarded as a physiological necessity by the medical profession, I have been met with a host of questions, mostly raised as objections, some samples of which, with their answers, will comprise this paper, and my hope is that they will help some one who is trying to secure obedience to this part of nature's requirements.

"Will not water make me fat?" It is a well-known fact that most people dread becoming unduly fat, and this question is a very common one. The answer is yes and no. Water will make you fat if it increase your ability to assimilate food, if by drinking more water you are enabled to take into the system more of the food that you eat. In no other way will it make you fat. There is evidently no fat in water. It will not make you fat if your digestion is perfect already, and you do not eat a great abundance of such foods as produce fat. In fact, I have often seen people reduce fat, who needed to do so, by drinking a large quantity of water and using a properly regulated diet.

"Will not so much water strain my kidneys?" is another question which is asked almost as frequently as the preceding one. The answer is simple. Water does not strain the kidneys any more than more help in building a house strains the workmen. The excretion of the kidneys is twofold—water and certain other materials which are the result of the wear on the tissues. This water is the vehicle in which are carried in solution all the ingredients of waste tissue which the system is trying to get rid of. The flow of water through the kidneys to the bladder simply furnishes a current in which to carry off the dissolved detritus; therefore the drinking of a physiological amount of water cannot strain the kidneys.

"If water will thin my blood when it is too thick, will it not make it too thin if I continue to drink so much?" This question is often asked by patients of plethoric habit and lithæmic tendencies whom I am trying to impress with the necessity of getting the system thoroughly washed out, and the question seems a logical one. The answer, however, makes it plain. The blood craves a certain percentage of water; that certain percentage it will take up and hold, provided a continual supply is being added; but with the blood pressure and circulation automatically regulated by the mechanism which is called the sympathetic nervous system, and with the ready outlet afforded by the kidneys, all water taken in above the amount required to keep the blood at its normal proportion of fluid and solid is passed on, through, and out, and does its duty simply by washing the system of its impurities. It is often the case that water given in free quantity to a patient suffering from anæmia so assists the digestion that it will help thicken the blood, while in a person of plethoric habit the action is quite the reverse.

"Will drinking a large amount of water continuously produce catarrh of the bowels or bladder?" This question has been seriously asked by patients, from the fact that a person unaccustomed to drinking the physiological amount of water finds the first effect of drinking such an amount to be the necessity of a frequent evacuation of the bladder, and not infrequently it may also cause looseness of the bowels. But we find by experience as well as by logic that the use of such an amount of water as is a physiological necessity does not produce catarrh of the bladder, but rather helps such troubles by so diluting the urine as to render it less irritating, thus giving nature a chance to cure the trouble. And not infrequently catarrh of the bowels may be due to an insufficient elimination by the kidneys, in which case the bowels attempt to take up work left undone by the kidneys, and the expression of this effort is indicated by the catarrh, which will be relieved by drinking a sufficiently large quantity of water.

"Will not drinking water make me perspire unduly?" Drinking water up to the physiological amount in the case of a person who has not perspired for years, owing to a lack of sufficient water, may temporarily produce excessive perspiration, such perspiration lasting only, like the flushing of the kidneys, until the system has been relieved of the poisons that can be excreted in that way. In other words, free action of the kidneys and skin, following the use of a normal amount of water when the patient has been for a long time deprived of that amount, is only Nature's expression of joy at having once received her deserts.

"Will not cold water chill my stomach and thereby cause harm?" The reply to this question is, Unduly cold water might: ice water, for instance; but water at a temperature making it pleasant to drink, say from 45° to 60° F., will not chill the stomach. An illustration from nature is shown in the fact that nearly all our

* Medical Record.

springs are cold, very few hot. Most of the water we drink should be cold; hot water should be used for other purposes than to supply the system with the necessary fluid.

But my patient says: "Water drinking gives me gas on the stomach, and if it does so I should not drink it, should I?" Why not? There is no gas in water. If gas appears in the stomach, or is noticed in the stomach after drinking water, it simply shows that gas was there before, and the water, displacing the gas, causes more or less eructation, and is frequently one of the best methods to relieve the stomach of gas.

"Doctor, if water turns sour on my stomach, I suppose it is a sign that water disagrees with me, isn't it?" Water does not turn sour in any one's stomach. It may bring to the knowledge of the patient the fact that an acid condition exists in the stomach, in the same way that it brings to him the knowledge of the presence of gas in the stomach, but it will not produce acidity any more than it will produce gas, and if acid is in the stomach, it was there before, and instead of making it worse, water will manifestly make it better. The more water we put into vinegar the less acid it is, and the more water we put into the stomach the less concentrated will be the acid, be it fermentation acid or not. Consequently, the answer to this question is that it is not a sign that water disagrees with a person, but a sign that something else needs attention, and the water is not contraindicated.

"Will not water, drunk at meals, retard digestion?" In a majority of cases the answer will be, No. It does not retard digestion unless it is drunk in undue quantity, and used as a means of washing the food down, to save the labor of properly masticating it and mixing it with saliva. A moderate quantity of water in most cases aids digestion by increasing the fluidity of the contents of the stomach, and thereby favoring the admixture of the gastric fluid with the food.

"Shall I drink hot or cold water?" The use of hot water is valuable when there is pain or distress in the stomach, and should be then favored. In the case of a delicate, sensitive stomach, when the patient cannot be induced to drink the necessary amount of cold water, it is often easier to get him to take it hot, but for general purposes most of the water drunk should be used cold, or cool, for the tonic effect of cool water on the stomach is greater than that of hot, just as its tonic effect on the skin is greater.

"I should not drink water, should I, unless I am thirsty?" The reply to this question is that the lack of thirst in a grown person is no indication of his need of water or not. A child is always thirsty, and we should be thirsty at proper intervals, so that the appetite would be a guide, if we did not, from preoccupation or some other cause which makes us inattentive to the impulse, neglect it, until we find it often absent altogether. When such a condition exists, manifestly thirst is not to be regarded as an indication of the patient's need, for many patients say they are never thirsty.

Several of the questions asked and answered in this paper owe their origin to theories that have come down from our ancestors in medicine, and perhaps from our grandmothers, who were not our ancestors in medicine. The absurdity of the old time notions about water may be well illustrated by the following extract, on the medical view of the use of water about three centuries ago, taken from The Hospital:

"It needed a very bold man to resist the medical testimony of three centuries ago against water drinking. Few writers can be found to say a good word for it. One or two only are concerned to maintain that 'when begun in early life it may be pretty freely drunk with impunity,' and they quote the curious instance given by Sir Thomas Elyot in his 'Castle of Health,' 1541, of the Cornishmen: 'Many of the poorer sort, which never, or very seldom, drink any other drink, be, notwithstanding, strong of body and like and live well until they be of great age.'

"Thomas Cogan, the medical schoolmaster of Manchester fame, confessed in his 'Haven of Health,' 1589, designed for the use of students, that he knew some who drank cold water at night or fasting in the morning without hurt; and Dr. James Hart, writing about fifty years later, could even claim among his acquaintance 'some honorable and worshipful ladies who drink little other drink, and yet enjoy more perfect health than most of them that drink of the strongest.' The phenomenon was undeniable, but the natural inference was none the less to be resisted.

"Sir Thomas Elyot himself is very certain, in spite of the Cornishmen, that 'there be in water causes of divers diseases, as of swelling of the spleen and liver.' He complains oddly also that 'it flitteth and swimmeth,' and concludes that 'to young men, and them that be of hot complexions, it doeth less harm, and sometimes it profiteth, but to them that are feeble, old, and melancholy, it is not convenient.'

"'Water is not wholesome cool by itself for an Englishman,' was the version of Andrew Borde—monk, physician, bishop, ambassador, and writer on santitation—as the result of a life's experience. And to quote the 'Englishman's Doctor':

"'Are enemies to health and good digestion,
Both water and small beer, we make no question.'

"But the most formal indictment against water is that of Venner, who, writing in 1622, ponderously pronounces: 'To dwellers in cold countries, it doth very greatly deject their appetites, destroy the natural heat, and overthrow the strength of the stomach, and consequently, confounding the concoction, is the cause of crudities, fluctuations and windiness in the body.'"

Capt. McCullagh, chief of the New York police, according to The Electrical Engineer, of New York, has submitted to the police commissioners a complete system of police inter-communication by means of telephonic posts connected to the police stations. He proposes to erect, in every fifth street running from east to west, at every street corner where an avenue crosses, an ornamental iron booth containing a telephone in connection with the police station. The policeman patroling the streets from east to west would in that manner always be within three blocks of a telephone post, and thus be able to communicate easily with the station, either to transmit reports or to receive instructions.

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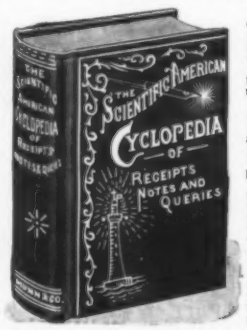

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